

SIR.
K. DIGBY

TWO
TREATISES

LONDON
1658

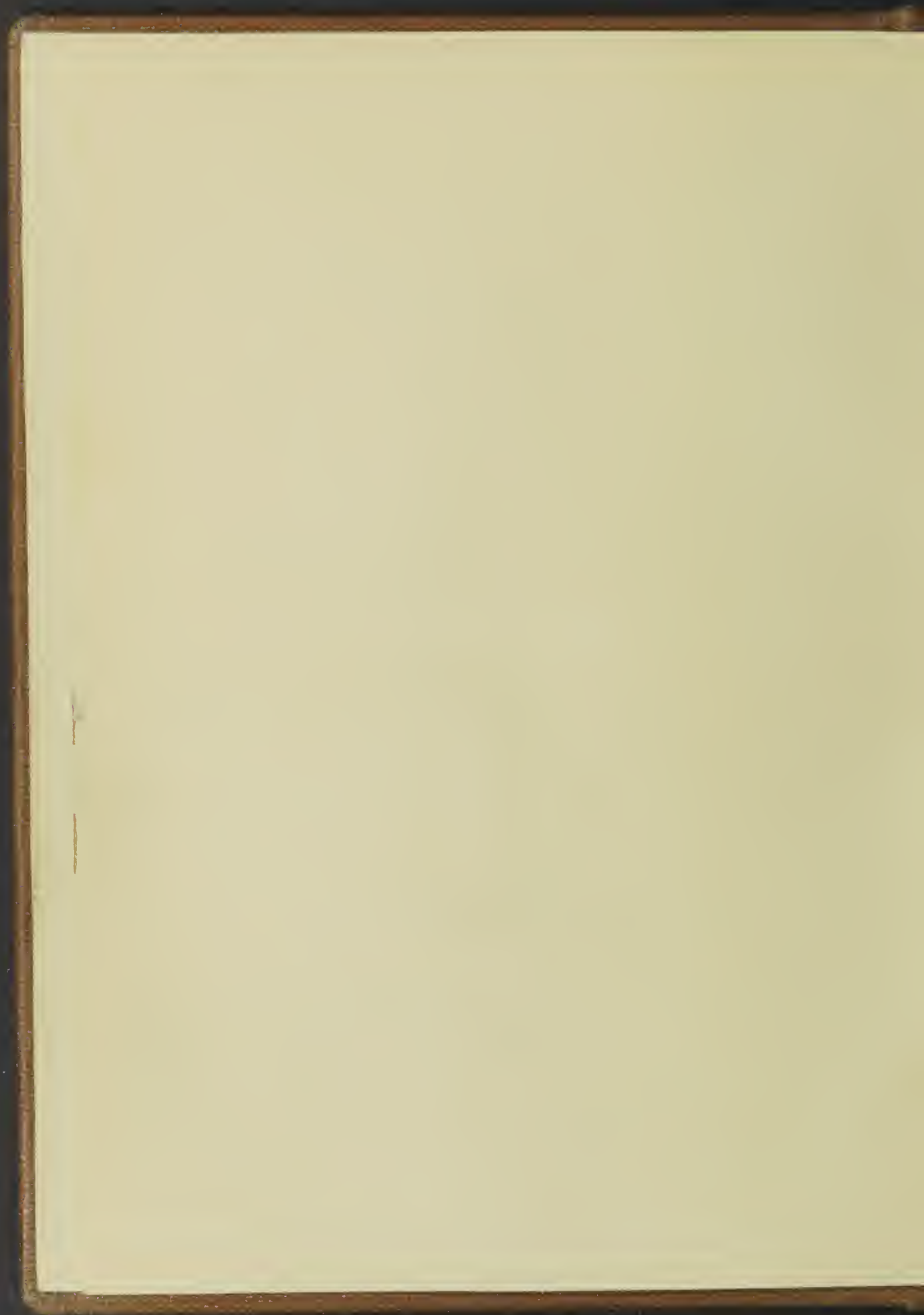






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R. H. To G. D. N. Sept. 1883.

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[Dijby (Sir Hendon)]

T W O

19266

TREATISES:

In the one of which,

THE NATURE OF BODIES;

In the other,

THE NATURE OF MANS SOUL,
IS LOOKED INTO:

IN WAY OF DISCOVERY
OF THE

IMMORTALITY
OF

REASONABLE SOULS.

Ψυχῆς φύσιν ἀξίως λόγῳ
Καταρτῆσαι δεῖ δυνατόν εἶναι,
Ἀλλ' ἢ τὸ ὅλα φύσις;

*Anima naturam, absque totius natura,
Sufficienter cognosci posse, existimas?*

Plato in Phædr.

L O N D O N,

Printed for John Williams, and are to be sold at
the Crown in S. Paul's Church-yard.

M DC LVIII.

WELLOME
HISTORICAL





T O M Y S O N N E, K E N E L M E D I G B Y.

S O N N E,



He calamity of this time being such, as hath bereft me of the ordinary means of expressing my affection to you; I have been casting about, to finde some other way of doing that in such sort, as you may receive most profit by it. Therein I soon pitched upon these Considerations; That Parents owe unto their children, not onely material subsistence for their Body, but much more, spiritual contributions to their better part, their Mind. I am much bound to God, that he hath indued you with one, very capable of the best instructions: and withall, I do therefore esteem my self obliged, to doe my utmost for moulding

it to its most advantage. If my aym therein do prove succesfull, you will with more ease digest those inconveniences and distresses which already you have begun to be acquainted with, and that threaten daily worse unto you. For how can a man suffer his heart to be dejected at the privation of any temporal blessings, whiles he considereth the inanity of them; and that nothing is worthy his serious thought, but what may accompany him to his eternal habitation? What needet he fear the desolations of war, and the worst that they can do against him, who have his estate in their power, when he may be rich with a much nobler treasure, that none but himself can rob him of? Without doubt, he that shall seriously reflect upon the excellency of his own nature, and upon the admirable perfect and happy state he shall most certainly arrive unto, if he but wean himself from those worldly impediments, that here clog his soules flight; cannot choose but look with a disdainfull eye, upon the glittering trifles, that weak spirits delight themselves withall. If he deem it not requisite (as of old, the famous wise man did) to throw away those
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encumbrances, to the end he may the more freely attend unto divine contemplations (for worldly goods, duly used, may be very advantageous both to ones self and to others) yet at the least, he will not repine at Fortunes recalling of what she formerly had but lent him, and but permitted him the use of.

To the end then that you may be armed against the worst that may arrive unto you, in this unhappy state of affairs, in our distressed Countrey; I send you those considerations of the nature and Immortality of humane soules, which of late, have been my chief entertainment. The progress you have already made in the Study of Philosophy, hath (I am perswaded) enabled you to benefit your self, with what I have written upon this subject: on the serious examining of which, if you will imploy but half the time, that I have done in spinning out my thoughts, and weaving them into the piece you see, I doubt not but you will thereby receive so much contentment, as well as profit, that you will not repent you of your pains. Besides that, intellectual entertainments are the purest, and the noblest, and the most proportionate

onate to mans nature, and prove the most delightful to him, when they are duly relished. You will presently agree, that the matter I handle, is the most important and the most weighty, within the whole extent of humane nature, for a worthy person to employ himself about. The advantage which Man hath over unreasonable creatures, is, that what he doth, is by election; and he is himself master of all his actions; whereas they are impelled by outward causes, unto all they do: it is properly said of them, that *aguntur magis quam agunt*: He onely is free; and in all varieties of circumstances, hath the power to choose one, and to reject another. Now, to have this election wisely made, and becoming a man, requireth that it be steered by knowledge. To do any thing well, a man must first know thoroughly all that concerneth the action he is about; and chiefly the end of it. And certainly, of all his actions, the government of himself, is the most important, and neerliest concerning him. The end of that government, and of all a mans aims, is by all men agreed to be Beatitude, that is, his being compleatly well, and in a condition of enjoying the most

most happiness, that his nature is capable of. For arrival whereunto, it is impossible to pitch upon the direct and sure means, unless it be first determined, whether the Beatitude we speak of, do belong to this life, or be not to be attained, till we come to the next: or rather, whether or no, there be another life besides this, to be happy in. For if there remaineth an eternity unto us, after the short revolution of time we so swiftly run over here on earth; it is clear, that all the happiness which can be imagined in this fleeting state, is not valuable, in respect of the future; nor any thing we do here is considerable, otherwise than as it conduceth to the making our condition then, better or worse. Now the way to be sure of this, is either infallible authority, or evident science. They that rely on the first, depend of others: and they onely who know, are absolutely compleat of themselves; and have within themselves, the principles whereby to govern their actions, in what is of highest consequence to them. It is true, every body is not of a strain of wit and judgement, to be of this rank: and who are not, must be contented to believe others, and be

satisfied with what is taught them. But he that will be of a superiour orb, must make this his study. This is the adequate entertainment of a worthy person.

To conceive how high and excellent, this science of governing a man in order to Beatitude in the next world is, we may consider, how among all Arts that concern this life, the art of a States-man, unto whom belongeth to see a Common-wealth well governed, is by much the noblest. All other Arts, are but ministerially to him. He maketh use of the Soldier, of the Lawyer, of the Orator, of the Antiquary, of the Physician, as best conduceth to the end he aimeth at, of making the Common-wealth he governeth, happy and flourishing. All other meaner Trades serve him in a yet lower degree. Yet after all, he must take his measures from the Metaphysician or Divine. For since the government of a society of men, aimeth at giving them the best being they are capable of; and since Mans well-being here in this life, is but instrumentally good, as being the means for him to be well in the next life; It is evident, that the States-mans art, is but instrumental to that, which

which sheweth, how every particular man must govern his life; to be partaker of a happy eternity. And consequently, if a Statesman hath not this science, he must be subject to a braver man than himself, whose province is to direct all his actions unto this end. We are told, how reverently great *Cæsar* listened to the discourses of learned *Achoreus*, how observant *Alexander* was of his Master *Aristotle*, how secure *Nero* trode, whiles *Seneca* guided his steps, how humble *Constantine* was to Saint *Sylvesters* precepts, how *Charlemain* governed himself in his most important actions, by *Alcuines* advice: In a word, all the great men of Antiquity, as well among the Romans, as among the Grecians, had their Philosophers, and Divines in their kind, belonging to them; from whom they might derive rules of living and doing as they ought upon all occasions, if themselves were not Masters in that superior and all-directing science. He that seeth not by his own light, must in this dangerous Ocean steer by the lantern which another hangeth out to him. If the person he relieth upon, either withholdeth the light from him, or sheweth him a false one, he is presently in the
dark,

dark, and cannot fail of losing his way. How great an authority had the Augurs and Priests among the rude Romans, to forbid any publick act, or to break any assembly upon pretence of Religious duties, when they liked not the business that was in agitation? The like may interested Divines among Christians do, if the Minister of State have not some insight into Divinity. He leadeth a vexatious life, that in his noblest actions is foregord with scruples, that he dareth not make a step, without the authority of another to warrant him.

Yet I do not conclude, that he by whom I design by the character of a brave man, should be a professed or a compleat Metaphysician or Divine, and consummate in every curious circumstance that belongeth to this science; it sufficeth him to know it in bulk; and to have so much Divinity, as in common occurrents, to be able to govern himself; and in special ones, to understand what, and why his Divine perswadeth him to any thing; so that even then, though not without help, yet he governeth himself, and is not blindly governed by another. He that aimeth at being a perfect
Horse-

Horseman, is bound to know in general (besides the art of riding) the nature and temper of Horses; and to understand the different qualities of Bits, Saddles, and other utensils of a Horseman; But the utmost exactness in these particulars, belongeth to Farriers, Saddlers, Smiths, and other Tradesmen; of all which, the judicious Rider knoweth how to make due use, when he hath occasion, for his principal end; which is, orderly governing his Horse. In like manner, he whom we design by a compleat brave man, must know solidly the main end of what he is in the World for: and withall, must know how to serve himself when he pleaseth, and that it is needfull to him, of the Divines high Contemplations, of the Metaphysicians subtile Speculations, of the natural Philosophers minute Observations, of the Mathematicians nice Demonstrations; and of whatsoever else of particular Professions, may conduce to his end; though without making any of them his professed business.

To lay grounds for such knowledge as this, is the scope of my ensuing Discourse. My first aim, was to beget it in my self: to
which

which end, the digesting my thoughts into order, and the setting them down in writing, was necessary: for without such strict examination of them, as the penning them affordeth one means to make, they would hardly have avoyded being disjoynted and roving ones. Now that I have done that, my next aim is that you, unto whom I wish as much good as unto my self, may reap as much benefit by the studying it, as I have done by the composing it.

My end then being a private one, as (looking no farther than you my Son, and my self) I have not endeavoured to express my conceptions either in the phrase, or in the language of the Schools. It will serve our turn, to comprehend the substance, without confining our selves to any scrupulous exactness, in what concerneth onely form. And the same consideration hath made me pass slightly over many particulars, in my first Treatise of the Nature of Bodies; upon which learned and witty men might spin out large Volums. For in that part, I aim no farther, than to shew what may be effected by corporeal agents. There, possibility serveth
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my turn, as well as the determinate indivisible point of truth. I am obliged to that onely in my main great theme; which is the soul. In regard of which, the numerous crooked narrow cranies, and the restrayned flexuous rivolets of corporea l things, are all contemptible, farther than the knowlege of them serveth to the knowledge of the soul. And a gallant man, whose thoughts fly at the highest game, requireth no farther insight into them, than to satisfie himself by what way they may be performed; and deemeth it far too mean for him, to dwell upon the subtilest of their mysteries for science sake.

Besides this liberty that the scope I aym at alloweth me of passing very cursorily over sundry particulars; I find now at my reading all over together, what I have written to deliver it to the Printer, that even in that which I ought to have done to comply with my owne designe and expectation, I am fallen very short; so that if I had not unwarily too far engaged my self for the present publishing it, truly I should have kept it by me, till I had once again gone over it. I find the whole piece very confusedly done;
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the stile unequal and unpolished ; many particulars (when they are not absolutely necessary to my main drift) too slightly touched, and far from being driven home : and in a word, all of it seemeth to be rather but a loose model and rough cast of what I designe to do, than a complete work thoroughly finished.

But since by my over-forward promising of this piece to several friends, that have been very earnest for it, I have now brought my self to that pass, that it would ill become me to delay any longer the publishing of something upon this subject and that obligations of another nature permit me not at the present to dwell any longer upon this (besides that, so lazie a braine as mine is, groweth soon wearie when it hath so entangled a skean as this is to unwind) I now send it you as it is, but with a promise, that at my first leisure, I will take a strict survey of it ; and then in another Edition, will polish, correct and add what shall appeare needfull to me. If any man shall take the Book out of your hand, invited by the Title and subject to look into it ; I pray you in my behalf represent unto him, how distant my profession is, and how contrary my education hath

hath been from writing of books. In every Art, the plainest that is, there is an Apprenti-ship necessary, before it can be expected one should work in it a fashionable piece. The first attempts are alwaies very imperfect aimings; and are scarce discernable what they are meant for, unless the Master guide his Scholars hand. Much more will rhe same happen in so difficult and spiny an affaire, as the writing upon such a nice and copious subject as this is, to one who is so wholly ignorant of the lawes of Method as I am.

This free and ingenious acknowledgment on my side, will I hope prevail with all ingenuous persons, who shall reade what I have written, to advertise me fairely (if they judge it worth their while) of what they dislike in it: to the end that in another more accurate Edition; I may give them better satisfaction. For besides what failings may be in the matter, I cannot doubt but that even in the expressions of it, there must often be great obscurity and shortness; which I, who have my thoughts filled with the things themselves, am not aware of. So that, what peradventure may seem very full to me, because every imperfect touch

touch bringeth into my mind the entire notion and whole chain of circumstances belonging to that thing I have so often beaten upon, may appear very crude and maimed to a stranger; that cannot guess what I would be at, otherwise than as my direct words do lead him.

One thing more I shall wish you to desire of them who happily may peruse these two Treatises; as well for their own sakes, as for mine. And that is, that they will not pass their censure upon any particular piece, or broken parcel of either of them, taken by it self. Let them draw the entire thred through their fingers, and let them examine the consequentness of the whole body of the doctrine I deliver; and let them compare it by a like survey with what is ordinarily taught in the Schools: and if they finde in theirs, many bracks and short ends which cannot be spun into an even piece, and in mine, a faire coherence throughout; I shall promise my selfe a favourable doom from them, and that they will have an acquiescence in themselves to what I have here presented them with: whereas, if they but ravel it over loosely, & pitch upon disputing

ting against particular conclusions, that at the first encounter of them single, may seem harsh unto them, (which is the ordinary course of flashy wits, who cannot fathom the whole extent of a large discourse) it is impossible but that they should be very much unsatisfied of me; and go away with a perswasion, that some such truths as upon the whole matter are most evident (one stone in the arch supporting another, and the whole) are meer Chymeras and wild paradoxes.

But (Son) it is time my Book should speak it self, rather than I speak any longer of it here. Read it carefully over, and let me see by the effects of your governing your self, that you make such right use of it, as I may be comforted in having chosen you to bequeath it unto. God in heaven bless you. *Paris the last of August, 1644.*

Your Loving Father,

KENELME DIGBY.

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THE



THE PREFACE.

THis writing was designed to have seen the light under the name of one Treatise. But after it was drawn in paper; as I cast a view over it, I found the Proæmial part (which is that which treateth of bodies) so ample in respect of the other (which was the end of it; and for whose sake I medled with it) that I readily apprehend my Reader would think I had gone much astray from my Text, when proposing to speak of the Immortality of Mans Soul, three parts of four of the whole Discourse, should not so much as in one word mention that soul; whose nature and properties I aymed at the discovery of. To avoid this incongruity, occasioned me to change the name and unity of the work; and to make the survey of bodies, a body by it self: though subordinate to the Treatise of the Soule. Which notwithstanding it be less in bulk than the other, yet I dare promise my Reader, that if he bestow the pains requisite to perfect himself in it, he will find as much time well spent in the due reading of it, as in the reading of the former Treatise, though far more large.

But I discern an objection obvious to be made, or rather a Question; Why I should spend so much time in the consideration of Bodies, whereas none that hath formerly written of this subject, hath in any measure done the like?

I might answer that they had, upon other occasions, first written of the nature of Bodies: as I may instance in Aristotle;

The Preface.

Aristotle; and sundry others, who either have themselves professedly treated the Science of Bodies, or have supposed that part sufficiently performed by other pens. But truly, I was by an unavoidable necessity herunto obliged: which is, a current of doctrine that at this day, much raigneth in the Christian Schools, where bodies and their operations, are explicated after the manner of spiritual things. For we having very slender knowledge of spiritual substances, can reach no farther into their nature, than to know that they have certain powers, or qualities; but can seldom penetrate so deep, as to descend to the particulars of such Qualities, or Powers: Now our modern Philosophers have introduced such a course of learning into the Schools, that unto all questions concerning the proper nature of Bodies, and their operations, it is held sufficient to answer, they have a quality, or a power to do such a thing. And afterwards they dispute whether this Quality or Power, be an Entity distinct from its subject, or no; and how it is separable, or unseparable from it, and the like. Conformable to this, who will look into the books, which are in vogue in these Schools, shall find such answers and such controversies every where, and few others. As, of the sensible qualities: ask what it is to be white or red, what to be sweet or sour, what to be odoriferous or stinking, what to be cold or hot? And you are presently paid with, that it is a sensible quality, which hath the power to make a wall white or red, to make a meat agreeable, or disagreeable to the taste, to make a gratefull or ungratefull smell to the nose, &c. Likewise they make the same questions and resolutions, of Gravity and Levity: as whether they be qualities, that is, entities distinct from their subject: and whether they be active or passive; which when they have disputed slightly, and in common, with logical arguments; they rest there, without any farther searching into the physical causes or effects of them. The like you shall find of all strange effects

The Preface.

of them. The Loadstone and Electrical bodies are produced for miraculous, and not understandable things; and in which, it must be acknowledged, that they work by hidden qualities, that mans wit cannot reach unto. And ascending to living bodies, they give it for a Maxim: that life is the action of the same Entity upon it self: that Sense is likewise a work of an intrinsecal power, in the part we call Sense, upon it self. Which, our predecessors held the greatest absurdities that could be spoken in Philosophy. Even some Physicians, that take upon them to teach the curing of our bodies, do often pay us with such terms; among them, you have long discourses of a retentive, of an expulsive, of a purging, of a consolidating faculty: and so of every thing that either passeth in our body, or is applied for remedy. And the meaner sort of Physicians know no more, but that such faculties are; though indeed they that are truly Physicians, know also in what they consist; without which knowledge it is much to be feared, Physicians will do more harm than good.

But to return to our subject: this course of doctrine in the Schools, hath forced me to a great deal of pains in seeking to discover the nature of all such actions (or of the main part of them) as were famed for incomprehensible: for what hope could I have, out of the actions of the soul to convince the nature of it to be incorporeal; if I could give no other account of bodies operations, than that they were performed by qualities occult, specifical, or incomprehensible? Would not my adversary presently answer, that any operation, out of which I should press the souls being spiritual, was performed by a corporeal occult quality? and that as he must acknowledge it to be incomprehensible, so must I likewise acknowledge other qualities of bodies, to be as incomprehensible: & therefore could not with reason press him, to shew how a body was able to do such an operation; as I should infer must of necessity proceed from

The Preface.

from a spirit, since that neither could I give account how the loadstone drew iron, or looked to the North; how a stone, and other heavy things were carried downwards; how sight or fantasie was made; how digestion or purging were effected; and many other such questions, which are so slightly resolved in the Schools.

Besides this reason, the very desire of knowledge in my self, and a willingness to be available unto others (at the least so far as to set them on seeking for it, without having a prejudice of impossibility in attaining it) was unto me a sufficient motive, to enlarge my discourse to the bulk it is risen unto. For what a misery is it, that the flower and best wits of Christendom, which flock to the Universities, under pretence and upon hope of gaining knowledge, should be there deluded; and after many years of toil and expence, be sent home again, with nothing acquired more than a faculty, and readiness to talk like Parrats of many things; but not to understand so much as any one; and withall with a perswasion that in truth nothing can be known? For setting knowledge aside, what can it avail a man to be able to talk of any thing? What are those wranglings, where the discovery of truth is neither sought, nor hoped for, but meerly vanity and ostentation? Doth not all tend, to make him seem and appear that which indeed he is not? Nor let any body take it ill at my hands, that I speak thus of the modern Schools: for indeed it is rather themselves than I that say it. Excepting Mathematicks, let all the other Schools pronounce their own minds, and say ingenuously, whether they themselves believe they have so much as any one demonstration, from the beginning to the ending of the whole course of their learning. And if all, or the most part, will agree that any one position is demonstrated perfectly, and as it ought to be, and as thousands of conclusions are demonstrated in Mathematicks; I am ready to undergo

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The Preface.

the blame of having calumniated them, and will as readily make them amends. But if they neither will nor can; then their own verdict cleareth me: and it is not so much I, as they, that make this profession of the shallowness of their doctrine. And to this purpose I have often heard the lamentations of divers, as great wits as any that converse in the Schooles, complaining of this defect. But in so great an evidence of the effect, proofs are superfluous.

Wherefore I will leave this subject, to declare what I have here designed, and gone about, towards the remedy of this inconvenience. Which is that whereas in the Schooles, there is a loose method, or rather none; but that it is lawfull, by the liberty of a Commentator, to handle any question, in any place (which is the cause of the slightness of their doctrine, and can never be the way to any science or certitude) I have taken my beginnings from the commonest things that are in nature: namely, from the notions of Quantity, & its first differences which are the most simple, and radical notions that are, and in which all the rest are to be grounded. From them I endeavour by immediate composition of them, and derivation from them, to bring down my discourse to the Elements, which are the primary and most simple bodies in nature. From these, I proceed to compounded bodies; first, to those that are called mixed; and then, to living bodies: declaring in common the proprieties & operations that belong unto them. And by occasion as I pass along, I light here and there on those operations, which seem most admirable in nature, to shew how they are performed; or at the least, how they may be performed: that though I miss in particular of the industry of nature, yet I may nevertheless hit my intent; which is, to trace out a way, how these and such like operations may be effected by an exact disposition, and ordering (though intricate) of quantitative and corporeal parts: and to shew, that they oblige us not to recur

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recur unto hidden and inexplicable qualities. And if I have declared so many of these, as may beget a probable persuasion in my reader, that the rest which I have not touched, may likewise be displayed, and shewed to spring out of the same grounds if curious and constant searchers into nature, will make their task to penetrate into them; I have therein obtained my desire and intent; which is onely, to shew from what principles, all kinds of corporeal operations do proceed; and what kind of operations all these must be, which may issue out of this principles: to the end, that I may from thence, make a step to raise my discourse to the contemplation of the soul; and shew, that her operations are such, as cannot proceed from those principles; which being adequate and common to all bodies, we may rest assured, that what cannot issue from them, cannot have a body for its source.

I will therefore end this preface, with entreating my Reader to consider, that in a discourse proceeding in such order as I have declared, he must not expect to understand, and be satisfied, with what is said in any middle or latter part, unless he first have read and understood what goeth before. Wherefore, if he cannot resolve with himself, to take it along orderly as it lyeth from the beginning, he shall do himself (as well as me) right, not to meddle at all with this book. But if he will employ any time upon it, to receive advantage by it, he must be content to take the pains to understand thoroughly every particular as it is set down. And if his memory will not serve him to carry every one along with him, yet at the last, let him be sure to remember the place where it is handled and upon occasion, return a look back upon it, when it may stand him in stead. If he thinketh this diligence too burthensome, let him consider that the writing hereof hath cost the Authour much more pains: who as he will esteem them exceedingly well employed, if they may contribute ought to the content or advantage

The Preface.

tage of any free and ingenuous mind; so if any others sha'l
express a neglect of what he hath with so much labour hewed
out of the hard rock of Nature; or shall discourteously cavil
at the notions he so freely imparteth unto them; all the re-
sentment he shall make thereof, will be to desire the first, to
consider, that their slight esteem of his work, obligeth them
to entertain their thoughts with some more noble and more
profitable subject, and better treated, than this is: and the la-
ter sort, to justifie their dislike of his doctrine, by delivering
a fairer and more compleat body of Philosophy, of their own.
Which if hereupon they do, his being the occasion of the ones
bettering themselves, and of the others bettering the world,
will be the best success he can wish his Book.

A Table.

A Table shewing what is contained in the several Chapters and Sections in this Treatise concerning Bodies.

The figures after the Chapters, are the Sections
belonging to every Chapter: which Sections
the Reader shall finde in every Chapter by
their figures in the Margin.

CHAP. I.

THE Preface. A preamble to
the whole discourse; con-
cerning notions in general.

1. Quantity is the first, and most obvious affection of a body.
2. Words do not express things as they are in themselves, but onely as they are painted in the minds of men.
3. The first error that may arise from hence; which is a multiplying of things, where no such multiplication is really found.
4. A second error: the conceiving of many distinct things as really one thing.
5. Great care to be taken to avoid the errors which may arise from our manner of understanding things.
6. Two sorts of words to express our notions, the one common to all men; the other proper to scholars.
7. Great errors arise by wresting words from their common mean.

ing, to express a more particular
or studied notion.

CHAP. II.

Of Quantity.

1. We must know the vulgar and common notion of Quantity, that we may understand the nature of it.
2. Extension or divisibility is the common notion of Quantity.
3. Parts of Quantity are not actually in their whole.
4. If parts were actually in their whole, Quantity would be composed of indivisibles.
5. Quantity cannot be composed of indivisibles.
6. An objection to prove that parts are actually in Quantity; with a declaration of the mistake from whence it proceedeth.
7. The solution of the former objection: and that sense cannot discern whether one part be distinguished from one another; or no.
8. An enumeration of the several
* specieses

A Table.

Species of Quantity, which confirmeth that the essence of it is divisibility.

CHAP. III.

Of Rarity and Density.

1. *What is meant by Rarity and Density.*
2. *It is evident that some bodies are rare and others dense; though obscure, how they are such.*
3. *A brief enumeration of the several properties belonging to rare and dense bodies.*
4. *The opinion of those philosophers declared, who put rarity to consist in an actual division of a body into little parts.*
5. *The former opinion rejected, and the ground of their error discovered.*
6. *The opinion of those philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.*
7. *The opinion of vacuities refuted.*
8. *Rarity and Density consist in the several proportions which Quantity hath to its substance.*
9. *All must admit in Physical bodies, a Metaphysical composition.*

CHAP. IV.

Of the four first qualities: and of the four Elements.

1. *The notions of density and rarity have a latitude capable of infinite variety.*
2. *How moistness and driness are begotten in dense bodies.*
3. *How moistness and driness are begotten in rare bodies.*
4. *Heat is a property of rare bodies, and cold of dense ones.*
5. *Of the two dense bodies, the less dense is more cold: but of the two rare ones, the less rare is less hot.*
6. *The extreme dense body is more drie, than the extreme rare one.*
7. *There are but four simple bodies: and these are rightly named Elements.*
8. *The Authour doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.*

CHAP. V.

Of the operations of the Elements in general. And of their Activities compared with one another.

1. *The first operation of the Elements is division, out of which result-*

A Table.

resulteth local motion.

2. What place is both notionally, and really.
3. Local motion is that division, whereby a body changeth its place.
4. The nature of quantity of it self is sufficient to unite a body to its place.
5. All operations amongst bodies are either local motion, or such as follow out of local motion.
6. Earth compared to water in activity.
7. The manner whereby fire getteth into fewel, proveth that it exceedeth earth in activity.
8. The same is proved by the manner, whereby fire cometh out of fewel and worketh upom other bodies.

CHAP. VI:

Of Light, what ti is.

1. In what sense the Authour rejecteth qualities.
2. In what sense the Authour doth admit of qualities.
3. Five arguments proposed to prove that light is not a body.
4. The two first reasons to prove light to be a body are, the resemblance it hath with fire; and because if it were a quality, it would alwaies produce an equal to it self.

5. The third reason, because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.

6. The fourth reason, from the manner of the generation and corruption of light, which agreeth with fire.

7. The fifth reason, because such properties belong to light as agree onely unto bodies.

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Two objections answered against light being fire, a more ample proof of its being such.

1. That all light is hot and apt to heat.
2. The reason why our bodies for the most part do not feel the heat of pure light.
3. The experience of burning glasses, and of soultry gloomy weather, prove light to be fire.
4. Philosophers ought not to judge of things by the rules of vulgar people.
5. The different names of light and fire, proceed from different notions of the same substance.
6. The reason why many times fire and heat are deprived of light.
7. What becommeth of the body of light when it dieth.

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8. *An experiment of some who pretend that light may be precipitated into powder.*
9. *The Authors opinion concerning lamps, pretended to have been found in tombs, with inconsumptible lights.*

CHAP. VIII.

An answer to three other objections formerly proposed against light being a substance.

1. *Light is not really in every part of the room it enlighteneth, nor fills entirely any sensible part of it, though it seem to us to do so.*
2. *The least sensible point of a diaphanous body, hath room sufficient to contain both air and light, together with a multitude of beams issuing from several lights without penetrating one another.*
3. *That light doth not enlighten any room in an instant, and that the great celerity of its motion doth make it imperceptible to our senses.*
4. *The reason why the motion of light, is not discerned coming towards us, and that there is some real tardity in it.*
5. *The planets are not certainly ever in that place where they appear to be.*
6. *The reason why light being a body, doth not by its motion shat-*

ter other bodies into pieces.

7. *The reason why the body of light is never perceived to be fanned by the wind.*
8. *The reasons for, and against lights being a body, compared together.*
9. *A summary repetition of the reasons which prove that light is fire.*

CHAP. IX.

Of local motion in common.

1. *No local motion can be performed without succession.*
2. *Time is the common measure of all succession.*
3. *What velocity is, and that it cannot be infinite.*
4. *No force so little, that is not able to move the greatest weight imaginable.*
5. *The chief principle of Mechanics, deduced out of the former discourse.*
6. *No moveable can pass from rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees which are below the obtained degree.*
7. *The conditions which help to motion, in the moveable are three; in the medium one.*
8. *No body hath any intrinsecal virtue to move it self towards any determine part of the universe.*
9. *The*

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9. The encrease of motion is alwayes made in the proportion of the odd numbers.
10. No motion can encrease for ever, without comming to a period.
11. Certain problemes resolved concerning the proportion of some moving Agents compared to their effects.
12. When a moveable cometh to rest, the motion doth decrease according to the rules of encrease.

CHAP. X.

Of gravity and Levity; and of Local motion, commonly termed Natural.

1. Those motions are called natural, which have constant causes; and those violent which are contrary to them.
2. The first and most general operation of the sun, is the making and raising of atoms.
3. The light rebounding from the earth with atoms, causeth two streams in the air; the one ascending, the other descending; and both of them in a perpendicular line.
4. A dense body placed in the air between the ascending and descending stream, must needs descend.
5. A more particular explication

of all the former doctrine touching gravity.

6. Gravity and levity do not signifie an intrinsecal inclination to such a motion in the bodies themselves which are termed heavy and light.
7. The more dense a body is, the more swiftly it descendeth.
8. The velocity of bodies descending doth not encrease in proportion to the difference that may be between their several densities.
9. More or less gravity doth produce a swifter or a slower descending of a heavy body. Aristotles argument to disprove motion in vacuo, is made good.
10. The reason why at the inferior quarter of a circle, a body doth descend faster by the arch of that quarter, than by the cord of it.

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An answer to objections against the causes of natural motion avowed in the former chapter and a refutation of the contrary opinion.

1. The first objection answered; why a hollow body descendeth slower than a solid one.
2. The second objection answered, and the reasons shown why atoms do continually overtake.

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take the descending dense body.

3. A curious question left undecided.
4. The fourth objection answered, why the descent of the same heavy bodies is equall, in so great inequality of the atomes which cause it.
5. The reason why the shelter of a thick body doth not hinder the descent of that which is under it.
6. The reason why some bodies sink, others swim.
7. The fifth objection answered concerning the descending of heavy bodies in streams.
8. The sixth objection answered; and that all heavy elements do weigh in their own spheres.
9. The seventh objection answered, and the reason why we do not feel the course of the air, and atoms that beat continually upon us.
10. How in the same body gravity may be greater than density, and density than gravity; though they be the same thing.
11. The opinion of gravities being an intrinsical inclination of a body to the center, refuted by reason.
12. The same opinion refuted by several experiences.

CHAP. XII.

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1. The state of the question touching the cause of violent motion.
2. That the medium is the onely cause, which continueth violent motion.
3. A farther explication of the former doctrine.
4. That the air hath strength enough to continue violent motion in a moveable.
5. An answer to the first objection; that air is not apt to converse motion: and how violent motion cometh to cease.
6. An answer to the second objection, that the air hath no power over heavy bodies.
7. An answer to the third objection, that an arrow should fly faster broad wayes than long wayes.

CHAP. XIII.

Of three sorts of violent motion Reflexion, Undulation and Refraction.

1. That reflexion is a kind of violent motion.
2. Reflexion is made at equal angles.
3. The causes and properties of undulation.

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| <p>4. Refraction at the entrance into the reflectent body is towards the perpendicular; at the going out, it is from it; when the second superficies is parallel to the first.</p> <p>5. A refutation of Monsieur des Cartes his explication of refraction.</p> <p>6. An answer to the Arguments brought in favour of Monsieur des Cartes his opinion.</p> <p>7. The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.</p> <p>8. A general rule to know the nature of reflection and refractions in all sorts of surfaces.</p> <p>9. A body of greater parts, and greater pores, maketh a greater refraction than one of lesser parts and lesser pores.</p> <p>10. A confirmation of the former doctrine, out of the nature of bodies that refract light.</p> | <p>is in bodies of least cise; and it is made by the force of Quantity.</p> <p>4. The second sort of conjunction, is compactedness in simple Elements, and it proceedeth from density.</p> <p>5. The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.</p> <p>6. The reason why liquid bodies do easily joyn together; and dry ones difficultly.</p> <p>7. That no two hard bodies can touch one another immediately.</p> <p>8. How mixed bodies are framed in general.</p> <p>9. The cause of the several degrees of solidity in mixed bodies.</p> <p>10. The rule whereunto are reduced all the several combinations of Elements in compounding of mixed bodies.</p> <p>11. Earth and water are the basis of all permanent mixed bodies.</p> <p>12. What kind of bodies those are where water is the basis, and earth the predominant Element over the ether two.</p> <p>13. Of those bodies, where water being the basis, air is the predominant element.</p> <p>14. What kind of bodies result, where water is the basis, and fire the predominant Element.</p> <p>15. Of those bodies, where water</p> |
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CHAP. XIV.

Of the composition, qualities & generation of mixed bodies.

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| <p>1. The connexion of this chapter with the rest, and the Authors intent in it.</p> <p>2. That there is a least cise of bodies; and that this least cise is found in fire.</p> <p>3. The first conjunction of parts</p> | <p>is</p> |
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is in excess, it alone being both the basis, and the predominant Element.

16. Of those bodies, where earth alone is the basis, and also the predominant in excess over the other three Elements.

17. Of those bodies where earth is the basis, & water the predominant element over the other two.

18. Of those bodies, where earth being the basis, air is the predominant.

19. Of those bodies, where earth being the basis, fire is the predominant.

20. All the second qualities of mixed bodies, arise from several combinations of the first qualities, and are at last resolved into several degrees of rarity and density.

21. That in the planets and stars there is a like variety of mixed bodies caused by light, as here upon earth.

22. In what manner the Elements do work upon one another, in the composition of mixed bodies: and in particular, fire, which is the most active.

23. A particular declaration touching the generation of metals.

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Of the dissolution of mixed bodies.

1. Why some bodies are brittle,

and others tough, are apt to withstand outward violence the first instrument to dissolve mixed bodies.

2. How outward violence doth work upon the most compacted bodies.

3. The several effects of fire, the second and chiefest instrument to dissolve all compounded bodies.

4. The reason why some bodies are not dissolved by fire.

5. The reason why fire melteth gold, but cannot consume it.

6. Why lead is easily consumed and calcined by fire.

7. Why and how some bodies are divided by fire into spirits, waters, oyls, salts, and earth. And what those parts are.

8. How water, the third instrument to dissolve bodies, dissolveth calx into salt; and so into terra damnata.

9. How waer mingled with salt, becometh a most powerful Agent to dissolve other bodies.

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1. What is the sphere of activity in corporeal agents.

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| <p>2. The reason why no body can work in distance.</p> <p>3. An objection answered against the manner of explicating the former axiom.</p> <p>4. Of reaction: and first in pure local motion, that each Agent must suffer in acting and act in suffering.</p> <p>5. The former doctrine applied to other local motions designed by particular names. And that Susseths argument is of no force against this way of Doctrine.</p> <p>6. Why some notions do admit of intension and remission; and others do not.</p> <p>7. That in every part of our habitable world; all the four elements are found pure in small atoms; but not in any great bulk.</p> | <p>6. That yce is not water rarified but condensed.</p> <p>7. How wind, snow, and hail are made; and wind by rain allaid.</p> <p>8. How parts of the same or divers bodies, are joyned more strongly together by condensation.</p> <p>9. Vacuities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.</p> <p>10. The true reason of the former effect.</p> <p>11. The reason why bodies of the same nature do joyn more easily together than others.</p> |
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Of rarefaction and condensation the two first motions of particular bodies.

1. The Authours intent in this and the following chapters.
2. That bodies may be rarified, both by outward heat; and how this is performed.
3. Of the great effects of Rarefaction.
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Of another motion belonging to particular bodies, called Attraction; and of certain operations termed magical.

1. What Attraction is, and from whence it proceedeth.
2. The true sense of the Maxim, that Nature abhorreth from vacuity.
3. The true reason of attraction.
4. Water may be brought by the force of attraction to what height soever.
5. The Doctrine touching the attraction of water in syphons.
6. That the syphon doth not prove water to weigh in its own orb.

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7. Concerning attraction caused by fire.
8. Concerning attraction made by virtue of hot bodies, annulets, &c.
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1. What is Filtration; and how it is effected.
2. What causeth the water in filtration to ascend.
3. Why the filter will not drop unless the label hang lower than the water.
4. Of the motion of Restitution: and why some bodies stand bent, others not.
5. Why some bodies return onely in part to their natural figure; others entirely.
6. Concerning the nature of those bodies which do shrink and stretch.
7. How great and wonderfull effects, proceed from small, plain, and simple principles.
8. Concerning Electrical attraction, and the causes of it.
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Of the Loadstones generation; and its particular motions.

1. The extreme heat of the Sun under the Zodiack, draweth a stream of air from each Pole into the Torrid Zone.
2. The atomes of these two streams coming together are apt to incorporate with one another.
3. By the meeting and mingling together of these streams at the Equator, divers rivolets of atoms of each Pole, are continued from one Pole to the other.
4. Of these atoms incorporated with some fit matter in the bowels of the earth, is made a stone.
5. This stone worketh by emanations, joynd with agreeing streams that meet them in the air; and in fine it is a loadstone.
6. A meethod for making experiences upon any subject.
7. The loadstones generation by atomes flowing from both Poles, is confirmed by experiments observed in the stone it self.
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Positions drawn out of the former doctrine, and confirmed by experimental proofs.

1. The operations of the loadstone are wrought by bodies and not by qualities.
2. Objections against the former position answered.
3. The loadstone is imbued with his virtue from another body.
4. The virtue of the loadstone is a double, and not one simple virtue.
5. The virtue of the loadstone worketh more strongly in the Poles of it, than in any other part.
6. The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.
7. Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.
8. Concerning the declination and other respects of a needle, towards the loadstone it toucheth.
9. The virtue of the loadstone goeth from end to end in lines almost parallel to the axis.
10. The virtue of a loadstone is not perfectly spherical though the stone be such.

11. The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies.

12. The main globe of the earth not a loadstone.

13. The loadstone is generated in all parts or climates of the earth.

14. The conformity betwixt the two motions of magnetick things, and of heavy things.

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A solution of certain Problemes concerning the loadstone, and a short sum of the whole doctrine touching it.

1. Which is the North, and which the South Pole of a loadstone.

2. Whether any bodies besides magnetick ones be attractive.

3. Whether an iron placed perpendicularly towards the earth doth get a magnetical virtue of pointing towards the north, or towards the south in that end that lieth downwards.

4. Why loadstones affect iron better than one another.

5. Gilberts reason refuted touching a capped loadstone, that taketh up more iron than one not capped; and an iron impregnated that in some case draweth more strongly than the stone it self.

6. Galileus his opinion touching the

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the former effects refuted.

7. The *Authours* solution to the former questions.

8. The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.

9. Why the variation of a touched needle from the north, is greater the nearer you go to the Pole.

10. Whether in the same part of the world a touched needle may at one time varie more from the north, and at another time less.

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A description of two sorts of living creatures; Plants and animals: & how they are framed in common to perform vital motion.

1. The connexion of the following Chapters with the precedent ones.

2. Concerning several comparisons of mixed bodies.

3. Two sorts of living creatures.

4. An engine to express the first sort of living creatures.

5. An other engine by which may be expressed the second sort of living creatures.

6. The two former Engines and some other comparisons applied to express the two several sorts of living creatures.

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A more particular survey of the generation of Animals, in which is discovered what part of the animals is first generated.

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2. The former opinion rejected.

3. The *Authours* opinion of this question.

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5. The *Authors* opinion concerning the generation of Animals declared and confirmed.

6. That one substance is changed into another.

7. Concerning the hatching of chickens, and the generation of other animals.

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10. That the heart is imbued with the general specifick virtues of the whole body, whereby is confirmed the doctrine of the two former paragraphs.

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2. That the several figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.
3. The former doctrine is confirmed by several instances.
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2. Monsieur des Cartes his opi-

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4. *That solid bodies may convey the motion of the air or sound to the organs of hearing.*
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Of sensation, or the motion whereby sense is properly exercised.

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7. Reasons against Monsieur des Cartes his opinion.

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4. How the attractive and secretive faculties work.
5. Concerning the concoctive faculty.
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2. What causeth us to remember.

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4. Of pain and pleasure.
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6. Of several pulses caused by passions.
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9. Concerning pain and pleasure caused by the memory of things past.
10. How so small bodies as atoms are, can cause so great motions in the heart.
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12. How men are blinded by passion.

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2. Of the Baboon that played on a guitar.
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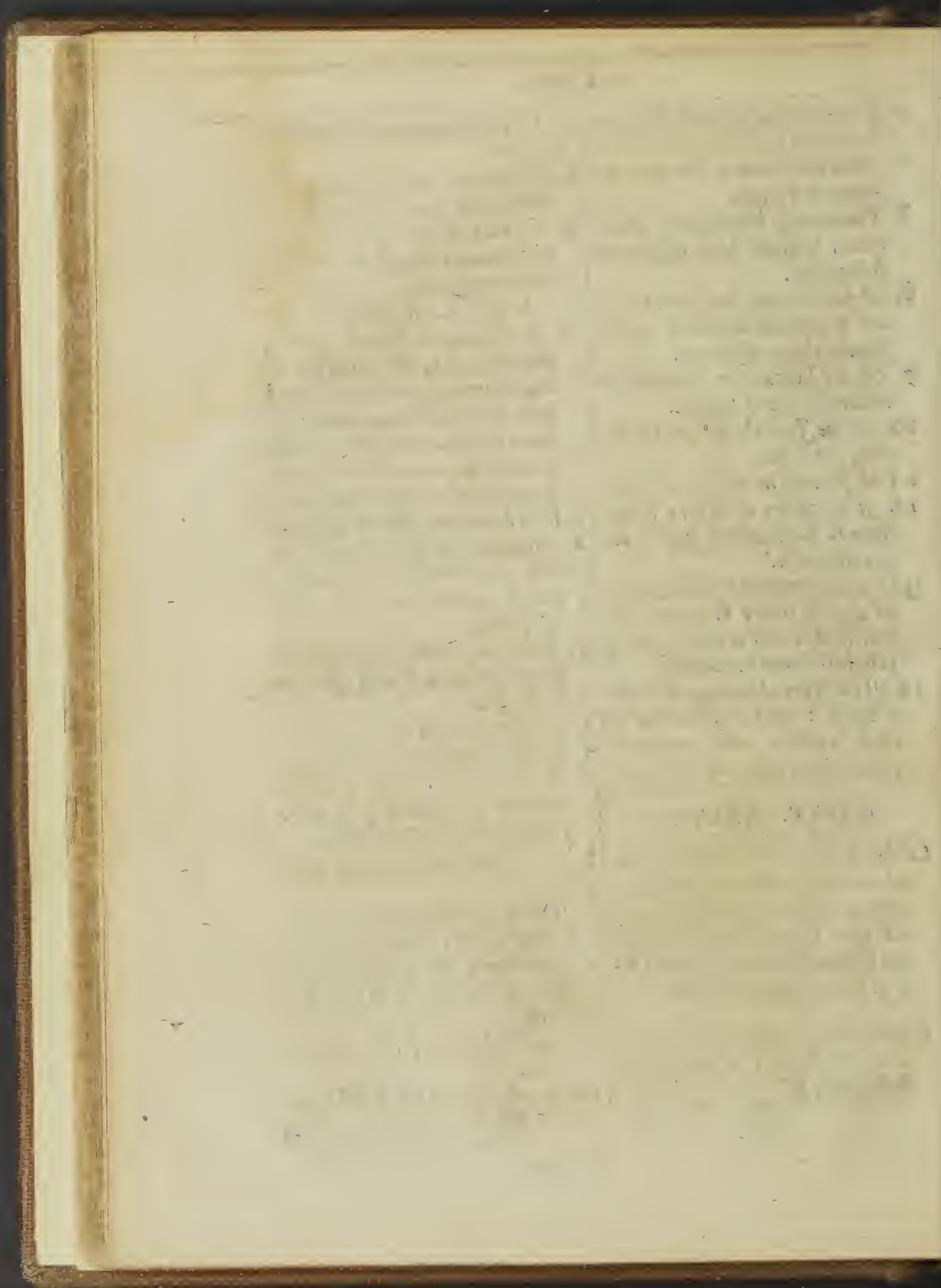
Of prescience of future events, providencies, the knowing of things never seen before; and such other actions, observed in some living creatures, which seem to be even above the reason that is in man himself.

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2. How some qualities caused at first by chance in beasts, may pass by generation to the whole off-spring.
3. How the parents fantasie doth oftentimes work strange effects in their issue.
4. Of Antipathies.
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6. That the Antipathy of beasts towards one another, may be taken away by assuefaction.
7. Of longing marks seen in children.
8. Why divers men hate some certain meats, & particularly cheese.
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A Table shewing what is contained in the several Chapters and Sections in this second Treatise, conceining *MANS SOUL*.

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1. What is a right apprehension of a thing.
2. The very thing it self is truly in his understanding, who rightly apprehendeth it.
3. The apprehension of things coming unto us by our senses, are resolvable into other more simple apprehensions.
4. The apprehension of a Being is the most simple and Basis of all the rest.
5. The apprehension of a thing is in next degree to that of Being, and it is the Basis of all the subsequent ones.
6. The apprehension of things known to us by our senses doth consist in certain respects betwixt two things.
7. Respect or relation hath not really any formal being, but onely in the apprehension of man.
8. That Existence or Being is the proper affection of man: and that mans soul is a comparing power.
9. A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.

10. A multitude of things may be united in mans understanding without being mingled or confounded together.

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12. Of universal notions.

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1. How a judgment is made by the understanding.

2. That two or more apprehensions are identified in the soul by uniting them in the stock of being.

3. How the notions of a substantive and an adjective, are united in the soul by the common stock of Being.

4. That a settled judgement becometh a part of our soul.

5. How the soul cometh to deem or settle a judgement.

6. How opinion is begotten in the understanding.

7. How faith is begotten in the understanding.

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8. Why

A Table.

8. *Why truth is the perfection of a reasonable soul: and why it is not found in simple apprehensions as well as in Enuntiations.*
9. *What is a solid judgement, and what a slight one.*
10. *What is an acute judgement, and what a dull one.*
11. *In what consisteth quickness and clearness of judgment: and there opposite vices.*

CHAP. III.

Of Discoursing.

1. *How discourse is made.*
2. *Of the figures and moods of syllogisms.*
3. *That the life of man as man, doth consist in discourse, and of the vast extent of it.*
4. *Of humane actions, and of those that concern our selves.*
5. *Of humane actions as they concern our neighbours.*
6. *Of Logick.*
7. *Of Grammer.*
8. *Of Rhetorick.*
9. *Of Poetry.*
10. *Of the power of speaking.*
11. *Of arts that concern dumb and insensible creatures.*
12. *Of Arithmetick.*
13. *Of Prudence.*
14. *Observations upon what hath been said in this chapter.*

CHAP. IV.

How a man proceedeth to action.

1. *That humane actions proceed from two several principles, understanding and sense.*
2. *How our general and inbred maxims do concur to humane action.*
3. *That the rules and maxims of arts do work positively in us, though we think not of them.*
4. *How the understanding doth cast about when it wanteth sufficient grounds for action.*
5. *How reason doth rule over sense and passion.*
6. *How we recall our thoughts from distractions.*
7. *How reason is sometimes overcome by sense and passion.*

CHAP. V.

Containing proofs out of our single apprehensions, that our soul is incorporeal.

1. *The connection of the subsequent chapters with the precedent.*
2. *The existence of corporeal things in the soul by the power of apprehension, doth prove her to be immaterial.*
3. *The notion of being, which is innate in the soul, doth prove the same.*
4. *The same is proved by the notion of respects.*

5. *That*

A Table.

5. That corporeal things are spiritualized in the understanding, by means of the souls working in and by respects.

6. That the abstracting of notions from all particular and individual accidents, doth prove the immateriality of the soul.

7. That the universality of abstracted notions do prove the same.

8. That collective apprehensions do prove the same.

9. The operations of the soul drawing alwaies from multitude to unity, do prove the same.

10. The difference betwixt the notion of a thing in our understanding, and the impression that correspondeth to the same thing in our fansie, doth prove the same.

11. The apprehension of negation and privations do prove the same

CHAP. VI.

Containing proofs of our souls operations in knowing or deeming any thing, that she is of a spiritual nature.

1. The manner of judging or deeming by apprehending two things to be identified, doth prove the soul to be immaterial.

2. The same is proved by the manner of apprehending opposition in a negative judgement.

3. That things in themselves op-

posite to one another having no opposition in the soul, doth prove the same.

4. That the first truths are identified to the soul.

5. That the soul hath an infinite capacity, and consequently is immaterial.

6. That the opposition of contradictory propositions in the soul doth prove her immateriality.

7. How propositions of eternal truth, do prove the immateriality of the soul.

CHAP. VII.

That our discoursing doth prove our soul to be incorporeal.

1. That in discoursing the soul containeth more in it at the same time then is in the fantasie, which proveth her to be immaterial.

2. That the nature of discourse doth prove the soul to be ordered to infinite knowledge, and consequently immaterial.

3. That the most natural objects of the soul are immaterial and consequently the soul her self is such.

CHAP. VIII.

Containing proofs out of our manner of proceeding to action, that our soul is incorporeal

1. That the souls being a power to order things, proveth her to be immaterial.

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2. That

A Table.

2. That the souls being able to move without being moved, doth prove her to be immateriall.
3. That the souls proceeding to action with an universality, and indifferency, doth prove the same.
4. That the quiet proceeding of reason doth prove the same.
5. A conclusion of what hath been said hitherto in this second Treatise.

CHAP. IX.

That our soul is a Substance, and Immortal.

1. That Mans soul is a substance.
2. That man is compound'd of some other substance besides his body.
3. That the soul doth subsist of it self independently of the body.
4. Two other arguments to prove the same: one positive, the other negative.
5. The same is proved because the soul cannot be obnoxious to the cause of mortality.
6. The same is proved because the soul hath no contrary.
7. The same is proved from the end, for which the soul was created.
8. The same is proved because she can move without being moved.

9. The same is proved from her manner of operation which is grounded in being.

10. Lastly, it is proved from the science of Morality, the principles whereof would be destroyed, if the soul were mortal.

CHAP. X.

Declaring what the soul of a man separated from his body, is: and of her knowledge and manner of working.

1. That the soul is one simple knowing act, which is a pure substance, and nothing but substance.
2. That a separated soul is in no place, and yet is not absent from any place.
3. That a separated soul is not in time, nor subject to it.
4. That the soul is an active substance, and all in it is activity.
5. A description of the soul.
6. That a separated soul knoweth all that which she knew while she was in her body.
7. That the least knowledge which the soul acquireth in her body of any one thing, doth cause in her, when she is separated from her body, a compleat knowledge of all things whatsoever.
8. An answer to the objections of some Peripateticks, who maintain

A Table.

tain the soul to perish with the body.

9. The former Peripateticks refuted out of Aristotle.
10. The operations of a separated soul compared to her operations in her body.
11. That a separated soul is in a state of pure being, and consequently immortal.

CHAP. XI.

Shewing what effects the diverse manners of living in this world do cause in a soul, after she is separated from her body

1. That a soul in this life is subject to mutation, and may be perfected in knowledge.
2. That the knowledges which a soul getteth in this life, will make her knowledge in the next life more perfect and firm.
3. That the souls of men addicted to science whilest they lived here, are more perfect in the next world, than the souls of unlearned men.
4. That those souls which embrace virtue in this world, will be most perfect in the next; and those which embrace vice, most miserable.

5. The state of a vicious soul in the next life.

6. The fundamental reason why as well happiness as misery is so excessive in the next life.

7. The reason why mans soul requireth to be in a body, and to live for some space of time joyned with it.

8. That the misery of the soul in the next world proceedeth out of inequality, and not out of falsity of her judgements.

CHAP. XII.

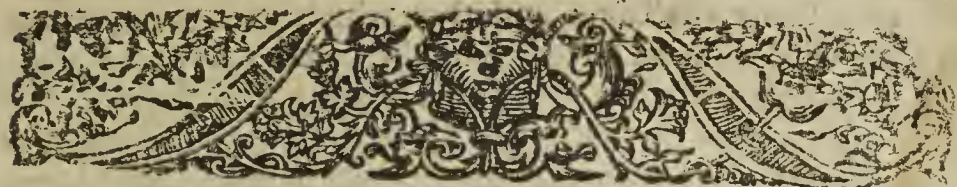
Of the perseverance of a soul, in the state she findeth her self in, at her first separation from her body.

1. The explication, and proof of that maxim, that, If the cause be in act, the effect must also be.
2. The effects of all such agents as work instantaneously, are compleat in the first instant that the agents are put.
3. All pure spirits do work instantaneously.
4. That a soul separated from her body, cannot suffer any change after the first instant of her separation.
5. That temporal sins are justly punished with eternal pains.

The Conclusion.

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Thos Hycle
His Book
1-7-66.



THE FIRST TREATISE DECLARING THE NATURE AND OPERATION OF BODIES.

CHAP. I.

*A Preamble to the whole discourse : Concerning Notions
in general.*



N delivering any Science, the clearest and smoothest method, and most agreeable to nature, is to begin with the consideration of those things that are most common and obvious; and by the dissection of them to descend by orderly degrees and steps (as they lie in the way) unto

I.
Quantity is the first and most obvious affection of a Body.

the examination of the most particular and remote ones. Now in our present intended survey of a Body, the first thing which occurreth to our sense in the perusal of it, is its *Quantity*, bulk, or magnitude: and this seemeth by all mankind to be conceived so inseparable from a body, as when a man would distinguish a corporeal substance from a spiritual one (which is accounted indivisible) he naturally pitcheth upon an apprehension of its having bulk, and being solid, tangible, and apt to make impression upon our outward senses; according to that expression of *Lucretius*, who studying Nature in a familiar and rational manner telleth us, *Tangere enim & tangi, nisi corpus nulla potest res*: And therefore in our inquiry of Bodies, we will observe that plain method which Nature teacheth us, and will begin with examining, *What Quantity is*, as being their

A first

first an primary affection; and that which maketh the things we treat of, be what we intend to signifie by the name of Body.

2. But because there is a great variety of apprehensions framed by learned men of the nature of *Quantity* (though indeed nothing can be more plain and simple than it is in it self) I conceive it will not be amisse, before we enter into the explication of it, to consider how the mystery of discoursing and expressing our thoughts to one another by words (a prerogative belonging onely to a man) is ordered and governed among us; that so we may avoid those rocks, which many, and for the most part, such as think they spin the finest threads, do suffer shipwreck against in their subtilst discourses. The most dangerous of all which, assuredly is when they confound the true and real natures of things, with the conceptions they frame of them in their own mindes. By which fundamental miscarriage of their reasoning, they fall into great errors and absurdities: and whatsoever they build upon so ruinous a foundation, proveth but uselesse cobwebs or prodigious Chymeras. It is true, words serve to expresse things; but if you observe the matter well, you will perceive they do so, onely according to the pictures we make of them in our own thoughts, and not according as the things are in their proper natures. Which is very reasonable it should be so, since the soul, that giveth the names, hath nothing of the things in her but these notions: and knoweth not the things otherwise than by these notions; and therefore cannot give other names but such as must signifie the things by mediation of these notions. In the things, all that belongeth unto them is comprised under one entire Entity: but in us, there are framed as many several distinct formal conceptions, as that one thing sheweth it self unto us with different faces. Every one of which conceptions seemeth to have for its object a distinct thing, because the conception it self is as much severed and distinguished from another conception or image, arising out of the very same thing that begot this, as it can be from any image painted in the understanding by an absolutely other thing.

3. It will not be amisse to illustrate this matter by some familiar example. Imagine I have an apple in my hand: the same fruit worketh different effects upon my several senses: my eye telleth

tellecth me it is green or red : my nose that it hath a mellow sent: which is a
my taste that it is sweet ; and my hand that it is cold and weigh- multiplying of
ty. My senses thus affected, send messengers to my phantasie things, where
with news of the discoveries they have made : and there, all of no such multi-
them make severall and distinct pictures of what entereth by plication is re-
their doors. So that my Reason (which discourseth upon ally sound.
what it findeth in my phantasie) can consider greenesse by
it self, or mellownesse, or sweetnesse, or coldnesse, or any
other quality whatsoever, singly and alone by it self, without
relation to any other that is painted in me by the same apple :
in which, none of these have any distinction at all, but are one
and the same substance of the apple, that maketh various and
different impressions upon me, according to the various dispo-
sitions of my severall senses : as hereafter we shall explicate
at large. But in my minde, every one of these notions is a di-
stinct picture by it self, and is as much severed from any of
the rest arising from the same apple, as it would be from
any impression or image made in me, by a stone or any o-
ther substance whatsoever, that being entire in it self and cir-
cumscribed within its own circle, is absolutely sequestred from
any communication with the other : so that what is but one
entire thing in it self, seemeth to be many distinct things in
my understanding : whereby, if I be not very cautious, and in
a manner wrestle with the bent and inclination of my un-
derstanding (which is apt to referre the distinct and com-
pleat stamp it findeth within it self, unto a distinct and
compleat original character in the thing) I shall be in dan-
ger before I am aware, to give actual beings to the quanti-
ty, figure, colour, smell, taste, and other accidents of the ap-
ple, each of them distinct one from another, as also from the
substance which they cloath ; because I finde the notions of
them really distinguished (as if they were different Entities)
in my minde. And from thence I may inferre, there is no
contradiction in nature to have the accidents really severed
from one another, and to have them actually subsist without
their substance : and such other mistaken subtilties, which arise
out of our unwary conceiting that things are in their own na-
tures after the same fashion as we consider them in our under-
standing.

4.
A second error; the conceiving of many distinct things as really one thing.

And this course of the mindes disguising and changing the impressions it receiveth from outward objects, into appearances quite differing from what the things are in their own real natures, may be observed not onely in multiplying Entities where in truth there is but one; but also in a contrary manner, by comprising several distinct things under one single notion; which if afterwards it be reflected back upon the things themselves, is the occasion of exceeding great errors, and entangleth one in unsuperable difficulties. As for example: Looking upon several cubes or dyes, whercof one is of Gold, another of Lead, a third of Ivory, a fourth of Wood, a fifth of Glasse, and what other matter you please; all these several things agree together in my understanding, and are there comprehended under one single notion of a cube; which (like a Painter that were to designe them onely in black and white) maketh one figure that representeth them all. Now if removing my consideration from this impression which the several cubes make in my understanding, unto the cubes themselves, I shall unwarily suffer my self to pin this one notion upon every one of them, and accordingly conceive it to be really in them; it will of necessity fall out by this misapplying of my intellectual notion to the real things, that I must allow Existence to other entities, which never had nor can have any in nature.

From this conception, *Plato's* Ideas had their birth; for he finding in his understanding one universal notion that agreed exactly to every individual of the same species of substance, which imprinted that notion in him; and conceiving that the picture of any thing must have an exact correspondence with the thing it representeth; and not considering that this was but an imperfect picture of the individual that made it; he did thence conceive, there was actually in every individual substance one universal Nature running through all of that species, which made them be what they were. And then considering that corporeity, quantity, and other accidents of matter, could not agree with this universal subsistent Nature, he denied all those of it: and so, abstracting from all materiality in his Ideas, and giving them a real and actual subsistence in nature, he made them like Angels, whose essences and formal reasons were to be the

the Essence and to give Existence unto corporeal individuals: and so each Idea was embodied in every individual of its species. Unto which opinion (and upon the same grounds) *Averroes* did lean, in the particular of mens souls. Likewise *Scotus* finding in his understanding an universal notion springing from the impression that individuals make in it, will have a like universal in the thing it self, so determining universals (to use his own language and terms) to be *à parte rei*; and expressing the distinction they have from the rest of the thing, by the terms of *actu formaliter, sed non realiter*: and thereby maketh every individual comprise an universal subsistent nature in it. Which inconvenience other moderne Philosophers seeking to avoid, will not allow these universals a real and actual subsistence; but will lend them onely a fictitious Being, so making them as they call them *Entia rationis*. But herein again they suffer themselves to be carried down the stream before they are aware by the understanding (which is apt to pin upon the objects, the notions it findeth within it self resulting from them) and do consider an unity in the things, which indeed is onely in the understanding.

Therefore one of our greatest cares in the guidance of our discourse, and a continual and sedulous caution therein, ought to be used in this particular, where every error is a fundamental one, and leadeth into inextricable labyrinths, and where that which is all our level to keep us upright and even (our understanding) is so apt, by reason of its own nature and manner of operation, to make us slide into mistaking and error. And to sum up in short what this discourse aimeth at, we must narrowly take heed, lest reflecting upon the notions we have in our mind, we afterwards pin those airy superstructures upon the material things themselves, that begot them; or frame a new conception of the nature of any thing by the negotiation of our understanding, upon those impressions which it self maketh in us: whereas we should acquiesce and be content with that natural and plain notion, which springeth immediately and primarily from the thing it self: which when we do not, the more we seem to excell in subtilty, the farther we go from reality and truth; like an arrow, which being wrong levelled at hand, falleth widest when shot in the strongest bow.

5.

Great care to be taken to avoid the errors which may arise from our manner of understanding things.

A 3

Now

6. Now to come to another point that maketh to our present purpose. We may observe there are two sorts of language to express our notions by: The one belongeth in general to all mankind, and the simplest person, that can but apprehend and speak sense, is as much judge of it, as the greatest Doctor in the Schools: and in this the words express the things properly and plainly, according to the natural conceptions that all people agree in making of them: The other sort of language is circled in with narrower bounds; and is understood onely by those that in a particular and express manner have been trained up unto it: and many of the words which are proper to it have been, by the authors of it, translated and wrested from the general conceptions of the same words, by some metaphor, or similitude, or allusion, to serve their private turns. Without the first manner of expressing our notions, mankind could not live in society together, and converse with one another: whereas, the other hath no farther extent, than among such persons as have agreed together to explicate and design among themselves particular notions peculiar to their arts and affairs.

Of the first kinde, are those ten general heads, which *Aristotle* calleth Predicaments: under which he (who was the most judicious orderer of notions, and director of mens conceptions, that ever lived) hath comprised whatsoever hath, or can have a being in nature. For when any object occurreth to our thoughts, we either consider the essential and fundamental Being of it; or we refer it to some species of Quantity; or we discover some qualities in it; or we perceive that it doth, or that it suffereth something; or we conceive it in some determinate place, or time, and the like. Of all which, every man living that enjoyeth but the use of reason, findeth naturally within himself at the very first naming of them, a plain, compleat, and satisfying notion; which is the same, without any the least variation, in all mankind: unless it be in such, as have industriously, and by force, and with much labour, perplexed and depraved those primary and sincere impressions, which nature had freely made in them.

Of the second sort, are the particular words of art, by which

which learned men use to express what they mean in Sciences; and the names of Instruments, and of such things as belong to trades, and the like: as a sign, a tangent, an epicycle, a deferent, an axe, a trowel, and such others; the intelligence of which belongeth not to the generality of man-kinde; but onely to Geometricians, Astronomers, Carpenters, Masons, and such persons as converse familiarly and frequently with those things. To learn the true signification of such words, we must consult with those that have the knowledge and practice of them: as in like manner, to understand the other kinde of plain language, we must observe how the words that compose it are apprehended, used, and applied by man-kinde in general; and not receive into this examination the wrested or Metaphorical senses of any learned men, who seek oftentimes (beyond any ground in nature) to frame a general notion that may comprehend all the particular ones, which in any sense, proper or improper, may arise out of the use of one word.

And this is the cause of great errors in discourse; so great and important, as I cannot too much inculcate the caution requisite to the avoiding of this rock. Which that it may be the better apprehended, I will instance in one example of a most plain and easie conception, wherein all mankind naturally agreeth, how the wresting it from its proper, genuine, and original signification, leadeth one into strange absurdities; and yet they pass for subtil speculations. The notion of being in a place, is naturally the same in all men living: ask any simple artizan, Where such a man, such a house, such a tree, or such a thing is; and he will answer you in the very same manner as the learnedst Philosopher would do: he will tell you, the man you ask for, is in such a church, sitting in such a piew, and in such a corner of it; that the house you enquire after, is in such a street, and next to such two buildings on each side of it; that the tree you would finde out, is in such a forest, upon such a hill, near such a fountain, and by such a bush; that the wine you would drink of, is in such a cellar, in such a part of it, and in such a cask. In conclusion, no man living that speaketh naturally and freely out of the notion he findeth clearly in his understanding, will give you

7.

Great errors arise by wresting words from their common meaning to express a more particular or studied notion.

other answer to the question of, *Where a thing is*, than such a one as plainly expresseth his conceit of being in place; to be no other, than a bodies being environed and inclosed by some one, or several others that are immediate unto it; as the place of a liquour, is the vessel that containeth it; and the place of the vessel, is such a part of the chamber or house that it resteth upon, together with the ambient air; which hath a share in making up the places of most things. And this being the answer, that every man whatsoever will readily give to this question; and every asker being fully satisfied with it; we may safely conclude, That all their notions and conceptions of being in a place, are the same; and consequently, that it is the natural and true one.

But then some others, considering that such conditions as these will not agree unto other things, which they likewise conceit to be in a place (for they receive it as an axiome from their sence, that whatsoever is, must be somewhere, and whatsoever is no where, is not at all) they fall to casting about how they may frame some common notion to comprehend all the several kinds of being in place, which they imagine in the things they discourse of. If there were nothing but bodies to be ranked by them in the Predicament of Place, then that description I have already set down would be allowed by them, as sufficient. But since that spirits and spiritual things (as Angels, rational souls, verities, sciences, arts, and the like) have a being in nature; and yet will not be comprised in such a kind of place as a body is contained in; they rack their thoughts to speculate out some common notion of being in place, which may be common to these, as well as to bodies; like a common accident agreeing to divers subjects. And so in the end, they pitch upon an Entity, which they call an *Ubi*: and they conceit the nature and formal reason of that to be, the ranking of any thing in a place, when that Entity is thereunto affixed. And then they have no farther difficulty, in setting an Angel, or any pure spirit, or immaterial essence, in a place as properly, and as compleatly, as if it were a corporeal substance. It is but assigning an *Ubi* to such a spirit, and he is presently riveted to what place you please: and by multiplying the *Ubies*,
any

any individual body unto which they are assigned, is at the same instant in as many distant places, as they allot it different *Ubies*: and if they assign the same *Ubi* to several bodies, so many several ones as they assigne it unto will be in one and the same place: and not onely many bodies in one place, but even a whole body in an indivisible, by a kind of *Ubi* that hath a power to resum: all the extended parts, and inclose them in a point of place. All which prodigious conceits and impossibilities in nature, do spring out of their mistake in framing Metaphysical and abstracted conceptions, instead of contenting themselves with those plain, easie, and primary notions, which nature stampeth alike in all men of common sence, and understanding. As who desireth to be farther instructed in this particular, may perceive, if he take the pains to look over what *M. White* hath discoursed of place, in the first of his Dialogues *De Mundo*. Unto which book I shall from time to time (according as I shall have occasion) refer my Reader in those subjects the Authour taketh upon him to prove; being confident, that his metaphysical demonstrations there, are as firm as any Mathematical ones (for Metaphysical demonstrations have in themselves as much firmness, certainty and evidencie as they) and so will appeare as evident as they, unto who-soever shall understand them thoroughly, and shall frame right conceptions of them: which (how plain soever they seem to be) is not the work of every pretender to learning.

CHAP. II.

Of Quantity.

AMong those primary affections which occur in the perusal of a body, *Quantity* (as I have observed in the precedent chapter) is one, and in a manner the first and the root of all the rest. Therefore (according to the caution we have been so prolix in giving, because it is of so main importance) if we aim at right understanding the true nature of it, we must examine, what apprehension all kinds of people (that is, mankind in general) maketh of it. By which proceeding, we do not make the ignorant multitude judge of that learning which groweth out of the consideration of *Quantity*: but onely

I.
We must know the vulgar and common notion of *Quantity*, that we may understand the nature of it.

ly of the natural notion which serveth learned men for a basis and foundation to build scientificall superstructures upon. For although Sciences be the works and structures of the understanding, governed and levelled by the wary and strict rules of most ingenuous artificers, yet the ground upon which they are raised, are such plain notions of things, as naturally and without any art, do present themselves to every mans apprehension; without which for matter to work upon, those artificial reflections would leave the understanding as unsatisfied, as a cook would the appetite by a dish upon which he should have exercised all his art in dressing it, but whose first substance were not meat of solid nutriment: it is the coarse market that must deliver him plain materials to employ his cunning upon: And in like manner, it is the indisciplined multitude that must furnish learned men with natural apprehensions, and notions to exercise their wits about: which when they have, they may use and order and reflect upon them as they please: but they must first receive them in that plain and naked form, as mankind in general pictureth them out in their imaginations.

And therefore the first work of Scholars is to learn of the people, *Quem penes arbitrium est & jus & norma loquendi*, what is the true meaning and signification of these primary names, and what notions they beget in the generality of mankind of the things they design. Of the common people then we must enquire, *What Quantity is*: and we shall soon be informed, if we but consider what answer any sensible man will make upon the sudden to a question whereof that is the subject: for such unstudied replies expresse sincerely the plaine and natural conceptions which they that make them have of the things they speak of. And this of Quantity is the plainest and the first that nature printeth in us, of all the things we see, feel, and converse withall; and that must serve for a ground unto all our other inquiries and reflections: for which cause we must be sure not to receive it wrested or disguised from its own nature.

2.
Extension or
divisibility is
the common
notion of
Quantity:

If then any one be asked, *What Quantity there is in such a thing, or how great it is*; he will presently in his understanding compare it with some other thing (equally known by both parties)

parties) that may serve for a measure unto it; and then answer, That it is as big as it, or twice as big, or not half so big, or the like: in fine, that it is bigger or lesser than another thing, or equal to it.

It is of main importance, to have this point thoroughly and clearly understood: therefore it will not be amiss to turne it and view it a little more particularly. If you ask what quantity there is of such a parcel of cloth, how much wood in such a piece of timber, how much gold in such an ingot, how much wine in such a vessel, how much time was taken up in such an action? he that is to give you an account of them, measureth them by ells, by feet, by inches, by pounds, by ounces, by gallons, by pints, by days, by hours, and the like; and then telleth you, how many of those parts are in the whole that you enquire of. Which answer, every man living will at the instant, without study, make to this question; and with it, every man that shall ask will be fully appoyed and satisfied: so that it is most evident, it fully expresth the notions of them both, and of all mankind, in this particular.

Wherefore, when we consider that Quantity is nothing else, but the extension of a thing; and that this extension is expressed by a determinate number of lesser extensions of the same nature; (which lesser ones, are sooner and more easily apprehended than greater; because we are first acquainted and conversant with such; and our understanding graspeth, weigheth and discerneth such more steadily; and maketh an exacter judgement of them) and that such lesser ones are in the greater which they measure, as parts in a whole; and that the whole by comprehending those parts, is a meer capacity to be divided into them; we conclude, That, *Quantity* or *Bigness*, is nothing else but divisibility; and that a thing is big, by having a capacity to be divided, or (which is the same) to have parts made of it.

This is yet more evident (if more may be) in Discreet Quantity (that is, in *number*) than in continued Quantity, or extension. For if we consider any number whatsoever, we shall find the essence of it consisteth in a capacity of being resolved and divided into so many unities, as are contained in it; which are the parts of it. And this species of Quantity being simpler than the other, serveth for a rule to determine it by: as we may observe

observe in the familiar answers to questions of continued Quantity, which expresse by number the content of it : as when one delivereth the Quantity of a piece of ground, by such a number of furlongs, acres, perches, or the like.

3.
Parts of Quantity are not actually in their whole.

But we must take heed of conceiving, that those parts, which we consider to discern the nature of Quantity, are actually and really in the *whole* of any continued one that containeth them. Ells, feet, inches, are no more reall Entities in the *whole* that is measured by them, and that maketh impressions of such notions in our understanding ; than in our former example, colour, figure, mellowness, taste, and the like, are severall substances in the apple that affecteth our severall senses with such various impressions. It is but one *whole* that may indeed be cut into so many severall parts : but those parts are not really there, till by division they are parcelled out : and then, the *whole* (out of which they are made) ceaseth to be any longer : and the parts succeed in lieu of it ; and are every one of them a new whole.

This truth is evident out of the very definition we have gathered of Quantity. For since it is *divisibility* (that is, a bare capacity to division) it followeth, that it is not yet divided : and consequently, that those parts are not yet in it, which may be made of it ; for division, is the making two or more things of one.

4.
If parts were actually in their whole, Quantity would be composed of indivisibles.

But because this is a very great controversie in schools, and so important to be determined and settled, as without doing so, we all be lyable to maine errors in searching the nature and operations of bodies ; and that the whole progress of our discourse, will be uncertaine and wavering, if this principle and foundation be not firmly laid ; we must apply our selves, to bring some more particular and immediate proof of the verity of this assertion. Which we will do, by shewing the inconvenience, impossibility and contradiction, that the admittance of the other leadeth unto. For if we allow actual parts to be distinguished in Quantity, it will follow that it is composed of points or indivisibles, which we shall prove to be impossible.

The first will appear thus : if Quantity were divided into all the parts into which it is divisible, it would be divided into indivisibles (for nothing divisible, and not divided, would remain in it) but it is distinguished into the same parts, into which

it w^{ould} be divided, if it were divided into all the parts into which it is divisible; therefore it is distinguished into indivisibles. The major Proposition is evident to any man that hath eyes of understanding. The minor is the confession or rather the position of the adversary, when he saith that all its parts are actually distinguished. The consequence cannot be calumniated, since that indivisibles, whether they be separated or joyned, are still but indivisibles; though that which is composed of them be divisible. It must then be granted that all the parts which are in Quantity, are indivisibles; which parts being actually in it, and the whole being composed of these parts onely, it followeth, that Quantity is composed and made of indivisibles.

If any should cavil at the supposition, and say, we stretch it farther than they intend it, by taking *all* the parts to be distinguished; whereas they mean onely that there are parts actually in Quantity, abstracting from *all*: by reason that *all*, in this matter, would inferre an infinity, which to be actually in any created thing, they will allow to be impossible. Our answer will be, to represent unto them how this is barely said, without any ground or colour of reason, meerly to evade the inconvenience that the argument driveth them unto. For if any parts be actually distinguished, why should not all be so? What prerogative have some that the others have not? And how came they by it? If they have their actual distinction out of their nature of being parts, then all must enjoy it alike, and all be equally distinguished, as the supposition goeth: and they must all be indivisibles, as we have proved. Besides, to prevent the cavil upon the word *all*, we may change the expression of the Proposition into a negative: for if they admit (as they do) that there is no part in Quantity, but is distinguished as far as it may be distinguished, then the same conclusion followeth with no less evidence; and all will prove indivisibles, as before.

But it is impossible that indivisibles should make Quantity; for if they should, it must be done either by a finite and determinate number, or by an infinite multitude of them. If you say not be composed of indivisibles. 5. Quantity can-
by a finite; let us take (for example) three indivisibles, and by adding them together, let us suppose a line to be composed; whose extent being onely longitude, it is the first and simplest species of Quantity, and therefore whatsoever is divisible into parts

parts, must be at the least a line. This line thus made, cannot be conceived to be divided into more parts than into three; since doing so you reduce it into the indivisibles that composed it. But *Euclide* hath demonstratively proved beyond all cavil (in the tenth Proposition of his sixth Book of Elements) that any line whatsoever may be divided into whatsoever number of parts; so that if this be a line, it must be divisible into a hundred or a thousand, or a million of parts: which being impossible in a line, that being divided into three parts onely, every one of those three is incapable of farther division: it is evident, that neither a line, nor any Quantity whatsoever, is composed or made of a determinate number of indivisibles.

And since that this capacity of being divisible into infinite parts, is a property belonging to all extension (for *Euclide's* demonstration is universal) we must needs confesse that it is the nature of indivisibles, when they are joyned together, to be drowned in one another, for otherwise there would result a kinde of extension out of them, which would not have that property; contrary to what *Euclide* hath demonstrated. And from hence it followeth that Quantity cannot be composed of an infinite multitude of such indivisibles; for if this be the nature of indivisibles, though you put never so great a number of them together, they will still drown themselves all in one indivisible point. For what difference can their being infinite, bring to them, of such force as to destroy their essence and property? If you but consider how the essential composition of any multitude whatsoever, is made by the continual addition of unitie, till that number arise; it is evident in our case that the infinity of indivisibles must also arise out of the continued addition of still one indivisible to the indivisibles presupposed: then let us apprehend a finite number of indivisibles, which (according as we have proved) do make no extension, but are all of them drowned in the first; and observing how the progresse unto an infinite multitude, goeth on by the steps of one and one, added still to this presupposed number: we shall see that every indivisible added, and consequently the whole infinity, will be drowned in the first number, as that was in the first indivisible.

Which will be yet plainer, if we consider that the nature of extension

extension requireth that one part be not in the same place, where the other is: then if this extension be composed of indivisibles, let us take two points of place in which this extension is, and inquire whether the indivisibles that are in each one of these points, be finite or infinite. If it be answered that they are finite, then the finite indivisibles in these two points make an extension; which we have proved impossible. But if they be said to be infinite; then infinite indivisibles are drowned in one point, and consequently have not the force to make extension. Thus then it remaineth firmly established, *That Quantity is not composed of indivisibles (neither finite, nor infinite ones) and consequently, That parts are not actually in it.*

Yet before we leave this point, although we have already been somewhat long about it, I conceive it will not be tedious, if we be yet a little longer, and bend our discourse to remove a difficulty that even Sense it self seemeth to object unto us. For doth not our eye evidently inform us, there are fingers, hands, arms, legs, feet, toes and variety of other parts in a mans body? These are actually in him, and seem to be distinct things in him, so evidently, that we cannot be perswaded, but that we see, and feel the distinction between them; for every one of them hath a particular power of actual working and doing what belongeth unto its nature to do: each finger is really there; the hand is different from the foot; the leg from the arm; and so of the rest. Are not these parts then actually and really in a mans body? And is not each of them as really distinguished from any other.

6.
An objection
to prove that
parts are actu-
ally in Quanti-
ty; with a des-
claration of the
mistake from
whence it pro-
ceedeth.

This appeareth at the first sight to be an insuperable objection, because of the confirmation and evidence that sense seemeth to give it. But looking neerly into the matter, we shall finde that difficulty ariseth not from what sense informeth us of; but from our wrong applying the conditions of our notions unto the things that make impressions upon our sense. Sense judgeth not which is a finger, which is a hand, or which is a foot. The notions agreeing to these words, as well as the words themselves, are productions of the understanding: which considering, several impressions made upon the sense by the same thing as it hath a virtue and power to several operations, frameth several notions of it: as in our former example, it doth
of

of colour, figure, taste, and the like, in an apple. For as these are not different bodies or substances, distinguished one from another; but are the same one entire thing, working severally upon the senses, and that accordingly, maketh these different pictures in the minde; which are there as much distinguished, as if they were pictures of different substances. So, the parts which are considered in Quantity, are not divers things, but are onely a virtue or power to be divers things: which virtue, making several impressions upon the senses, occasioneth several notions in the understanding; and the understanding is so much the more prone to conceive those parts as distinct things, by how much Quantity is neerer to be distinct things, than the qualities of the apple are. For Quantity, is a possibility to be made distinct things by division: whereas the others are but a virtue to do distinct things. And yet (as we have touched above) nothing can be more manifest, than that if Quantity be divisibility (which is a possibility, that many things may be made of it) these parts are not yet divers things. So that, if (for example) a rod be laid before us, and half of it be hid from our sight, and the other half appear; it is not one part or thing that sheweth it self, and another part or thing that doth not shew it self: but it is the same rod or thing, which sheweth it self according to the possibility of being one new thing, but doth not shew it self according to the possibility of being the other of the two things it may be made by division. Which example if it be well considered will make it much more easily sink into us, that a hand, or eye, or foot, is not a distinct thing by it self; but that it is the man, according as he hath a certain virtue or power in him to distinct operations. For if you sever any of these parts from the whole body; the hand can no more hold; nor the eye see; nor the foot walk; which are the powers that essentially constitute them to be what they are: and therefore they are no longer a hand, an eye, or a foot.

7.
The solution
of the former
objection: and
that sense can
not discern
whether one
part be distin-
guished from
another, or no.

Now then to come to the objection; let us examine how far sense may be allowed to be judge in this difficulty: and we shall finde, that Sense cannot determine any one part in a body: for if it could, it would precisely tell, where that part beginneth or endeth: but it being agreed upon that it beginneth and endeth in indivisibles; it is certain, that Sense cannot determine of them.

If

If then sense cannot determine any one part, how shall it see that it is distinguished from all other parts? Again, considering that all that whereof sense is capable is divisible, it still telleth us, that in all it seeth, there are more parts than one: and therefore it cannot discern, nor inform us of any that is one alone: nor knoweth what it is to be one; for it never could discern it: but what is many, is many *ones* and cannot be known, by that, which knoweth not, what it is to be one: and consequently sense cannot tell us, that there are many. Wherefore it is evident, that we may not rely upon sense for this question. And as for reason, she hath already given her verdict.

So that nothing remaineth but to shew, why we talk as we do, in ordinary discourse, of many parts: and that what we say in that kinde, is true, notwithstanding the unity of the thing. Which will appear plainly, if we consider that our understanding hath a custom for the better discerning of things, to impose upon a thing as it is under one notion, the exclusion of it self as it is under other notions. And this is evident unto all Scholars, when the mark of exclusion is expressly put: as when they speak of a white thing, adding the reduplication, *as it is white*: which excludeth all other considerations of that thing besides the whitenesse of it: but when it cometh under some particular name of the thing, it may deceive those that are not cunning: though indeed, most men discover it in such names as we call abstracted; as Humanity, Animality, and the like. But it easily deceiveth when it cometh in concrete names; as it doth in the name of *Part* in general, or in the names of particular parts; as a hand, an eye, an inch, an elle, and others of the like nature: for as you see that a part excludeth both the notion of the whole, and of the remaining parts; so doth a hand, an eye, an elle, exclude all the rest of that thing, whereof the hand is a hand, and the elle is an elle, and so forth. Now then, as every man seeth evidently that it cannot be said, the wall as it is white is plaster or stone: no more can it be said, that the hand of a man is his foot; because the word *hand* signifieth as much in it self, as if the man were taken, by reduplication, to be the man as he is hand, or as he hath the power of holding. So likewise, in the rod we spoke of before, it cannot be said that the part seen is the part unseen; because the part
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seen,

seen, signifieth the rod as it is a possibility to be made by division such a thing, as it appeareth to the sight. And thus it is clear how the difficulty of this point, ariseth out of the wrongfull applying the conditions of our notions, and of names, to the objects and things which we know : whereof we gave warning in Chap. 1. §. 2, 3. the beginning.

8. After which there remaineth no more to be said of this subject, but to enumerate the severall specieses of Quantity, according to that division which Logicians for more facility of discourse have made of it. Namely, these six, magnitude, place, motion, time, number, and weight. Of which, the two first are permanent, and lie still exposed to the pleasure of whosoever hath a minde to take a survey of them. Which he may do by measuring what parts they are divisible into ; how many ells, feet, inches, a thing is long, broad, or deep ; how great a place is ; whether it be not bigger or lesser than such another ; and by such considerations as these ; which do all agree in this, that they expresse the essence of those two specieses of Quantity, to consist in a capacity of being divided into parts.

The two next, motion and time ; though they be of a fleeting propriety, yet it is evident that in regard of their original and essential nature, they are nothing else but a like divisibility into parts ; which is measured by passing over so great or so little distance ; and by years, daies, hours, minutes, and the like. Number we also see is of the same nature ; for it is divisible into so many determinate parts, and is measured by unities, or by lesser numbers so or so often contained in a proposed greater. And the like is evident of weight, which is divisible into pounds, ounces, drams, or grains ; and by them is measured. So that looking over all the severall specieses of Quantity ; it is evident, our definition of it is a true one, and expresseth fully the essence of it, when we say it is a *divisibility*, or a capacity to be divided into parts ; and that no other notion whatsoever, besides this, reacheth the nature of it.

CHAP. III.

Of Rarity and Density.

I Intend in this Chapter to look as far as I can into the nature and causes of the two first differences of bodies which follow out of Quantity as it concurrerth with substance to make a body: for, the discovery of them, and of the various proportions of them among themselves, will be a great and important step in the journey we are going. But the scarcity of our language is such, in subjects removed from ordinary conversation, (though in others, I think none is more copious or expressive) as affordeth us not apt words of our own to express significantly such notions as I must busie my self about in this discourse. Therefore I will presume to borrow them from the Latine School, where there is much ado about them. I would express the difference between bodies, that under the same measures and outward bulk, have a greater thinness and expansion, or thickness and solidity, one than another; which terms, (or any I can finde in English) do not signifie fully those affections of Quantity that I intend here to declare: therefore I will do it under the names of Rarity and Density; the true meaning of which will appear by what we shall hereafter say.

I.

What is meant
by Rarity and
Density.

It is evident unto us, that there are different sorts of bodies, of which though you take equal quantities in one regard, yet they will be unequal in another. Their magnitudes may be the same, but their weights will be different; or contrariwise, their weights being equal, their outward measures will not be so. Take a pint of air; and weigh it against a pint of water, and you will see the ballance of the last go down a main: but if you drive out the air by filling the pint with lead, the other pint in which the water is, will rise again as fast: which if you pour out, and fill that pint with quicksilver, you will perceive the lead to be much lighter: and again, you will finde a pint of gold heavier than so much Mercury. And in like manner, if you take away of the heavy bodies till they agree in weight with the lighter, they will take up and fill different proportions, and parts of the measure that shall contain them.

2.

It is evident
that some do-
dies are rare
and others
dense; though
obscure, how
they are such.

But from whence this effect ariseth, is the difficulty that we

would lay open. Our measures tell us their quantities are equal, and reason assureth us, there cannot be two bodies in one and the same place; therefore when we see that a pinte of one thing outweigheth a pinte of another that is thinner, we must conclude, that there is more body compacted together in the heavy thing than in the light: for else how could so little of a solid or dense thing be stretched out to take up so great room, as we see in a basin of water that being rarified into smook or air, filleth a whole chamber? and again, shrink back into so little room, as when it returneth into water, or is contracted into ice? But how this comprehension of more body in equal room is effected, doth not a little trouble Philosophers.

3.
A brief enumeration of the several properties belonging to the rare and dense bodies.

To finde a way that may carry us through these difficulties that arise out of the Rarity and Density of bodies, let us do as Astronomers when they enquire the motions of the Sphears and Planets: they take all the Phenomena or several appearances of them to our eyes; and then attribute to them such orbs, courses, and periods, as may square and fit with every one of them; and by supposing them, they can exactly calculate all that will ever after happen to them in their motions. So let us take into our consideration the chief properties of rare and dense bodies, and then cast with our selves to finde out an Hypothesis or supposition (if it be possible) that may agree with them all.

First, It seemeth unto us, that dense bodies have their parts more close and compacted than others have that are more rare and subtil. Secondly, They are more heavy than rare ones. Again, the rare are more easily divided than the dense bodies: for water, oyl, milk, honey, and such like substances will not onely yield easily to any harder thing that shall make its way through them; but they are so apt to division and to lose their continuity, that their own weights will overcome and break it: where as in Iron, Gold, Marble, and such dense bodies, a much greater weight and force is necessary to work that effect. And indeed if we look well into it, we shall finde that the rarer things are as divisible in a lesser Quantity, as the more dense are in a greater: and the same force will break the rarer thing into more and lesser parts, than it will an equal one that is more dense. Take a stick of light wood of such a big-

nesse

ness that being a foot long, you may break it with your hands, and another of the same bigness, but of a more heavie and compacted wood, and you shall not break it, though it be two foot long: and with equal force you may break a loaf of bread into more and less parts, than a lump of lead that is of the same bigness. Which also will resist more to the division of fire (the subtillest divider that is) than so much water will; for the little atoms of fire (which we shall discourse of hereafter) will pierce and cut out in the water, almost as little parts as themselves, and mingling themselves with them they will flie away together, and so convert the whole body of water into subtil smoke: whereas the same Agent, after long working upon lead will bring it into no less parts than small graines of dust, which it calcineth it into. And gold, that is more dense than lead, resisteth peremptorily all the dividing power of fire; and will not at all be reduced into calx and lime, by such operation as reduced lead into it.

So that remembring how the nature of Quantity is Divisibility; and considering that rare things are more divisible than dense ones; we must needs acknowledge that the nature of quantity is some way more perfectly in things that are rare, than in those that are dense. On the other side, more compacted and dense things, may haply seem to some to have more Quantity than those that are rare; and that it is but shrunk together, which may be stretched out and driven into much greater dimensions than the Quantity of rare things, taking the quantities of each of them equal in outward appearance. As gold may be beaten into much more and thinner leaf, than an equal bulk of silver or lead. A wax candle will burn longer with equal light, than a tallow candle of the same bigness; and consequently, be converted into a greater quantity of fire and air. Oyl will make much more flame than spirit of wine, that is far rarer than it.

These and such like considerations have much perplexed philosophers, and have driven them into diverse thoughts to find out the reasons of them. Some observing that the dividing of a body into little parts, maketh it less apt to descend, than when it is in greater; have believed the whole cause of lightness and rarity to be derived from division. As for example, they

4.
The opinion
of those Philo-
sophers decla-
red, who put
rarity to consist
in an actual
division of a
Body into lit-
tle parts.

finde that lead cut into little pieces, will not go down so fast in water, as when it is in bulk : and it may be reduced into so small atoms, that it will for some space swim upon the water like dust of wood.

Which assumption is proved by the great *Galileus*; unto whose excellent wit and admirable industry the world is beholding, not only for his wonderfull discoveries made in the heavens, but also for his accurate and learned declaring of those very things that lie under our feet. He, about the 90. Page of his first Dialogue of motion, doth clearly demonstrate how any real medium must of necessity resist more the descent of a little piece of lead, or any other weighty matter, than it would a greater piece: and the resistance will be greater and greater, as the pieces are lesser and lesser. So that as the pieces are made less, they will in the same medium sink the slower; and do seem to have acquired a new nature of lightness by the diminution: not onely of having less weight in them than they had; as half an ounce is less than a whole ounce: but also of having in themselves a less proportion of weight to their bulk than they had; as a pound of cork is in regard of its magnitude lighter than a pound of lead: so as they conclude, that the thing whose continued parts are the lesser, is in its owne nature the lighter and the rarer; and other things whose continued parts are greater, they be heavier and denser.

3.
The former opinion rejected, and the ground of their error discovered.

But this discourse reacheth not home: for by it the weight of any body being discovered by the proportion it hath to the medium in which it descendeth, it must ever suppose a body lighter than it self in which it may sink and go to the bottom. Now of that lighter body, I enquire, what maketh it be so; and you must answer by what you have concluded, that it is lighter than the other, because the parts of it are less, and more severed from one another: for if they be as close together, their division availeth them nothing, since things sticking fast together, do work as if they were but one, and so a pound of lead, though it be filed into small dust, if it be compacted hard together, will sink as fast as if it were in one bulk.

Now then allowing the little parts to be separated, I ask, what other body filleth up the spaces between those little parts of the medium in which your heavy body descended? For if the

the parts of water are more severed than the parts of lead, there must be some other substance to keep the parts of it asunder: let us suppose this to be air: and I ask, whether an equal part of air be as heavie as so much water? or whether it be not? if you say, it is; then the compound of water and air must be as heavie as lead; seeing that their parts one with another are as much compacted as the parts of lead are. For there is no difference whether those bodies, whose little parts are compacted together, be of the same substance, or of divers, or whether the one be divided into smaller parts than the other, or no, (so they be of equal weights) in regard of making the whole equally heavie: as you may experience, if you mingle pin-dust with sand of equal weight, though it be beaten into far smaller divisions than the pin-dust, and put them in a bag together.

But if you say, that air is not so heavie as water; it must be, because every part of air hath again its parts more severed by some other body, than the parts of water are severed by air. And then I make the same instance of that body which severeth the parts of air. And so at the last - (since there cannot actually be an infinite process of bodies one lighter than another) you must come to one, whose little parts filling the pores and spaces between the parts of the others, have no spaces in themselves to be filled up.

But as soon as you acknowledge such a body to be lighter and rarer than all the rest, you contradict and destroy all you said before. For by reason of its having no pores, it followeth by your rule, that the little parts of it must be as heavie, if not heavier than the little parts of the same bigness of that body whose pores it filleth; and consequently it is proved by the experience we alleged of pin-dust mingled with sand, that the little parts of it cannot by their mingling with the parts of the body in which it is immediately contained, make that lighter than it would be if these little parts were not mingled with it. Nor would both their parts mingled with the body which immediately containeth them, make that body lighter. And so proceeding on in the same sort through all the mingled bodies, till you come to the last, that is immediately mingled with water; you will make water nothing the lighter, for being mingled with all these; and by consequence it should be as heavie and as dense as lead.

Now that which deceived the authours of this opinion, was, that they had not a right intelligence of the causes which made little parts of bodies (naturally heaver) descend slowly, in regard of the velocity of greater parts of the same bodies descending: the doctrine of which we intend to deliver hereafter.

6. Others therefore perceiving this rule to fall short, have endeavoured to piece it out by the mixtion of vacuity among bodies; believing it is that which maketh one rarer than another. Which mixtion they do not put alwaies immediate to the main body they consider: but if it have other rarer and lighter bodies mingled with it, they conceive this mixtion immediate onely to the rarest, or lightest. As for example; a chrystal being lighter and consequently being rarer than a diamond, they will not say that there is more vacuity in a chrystal than in a diamond; but that the pores of a chrystal are greater, and that consequently there is more air in a chrystal to fill the pores of it, than is in a diamond; and the vacuities are in the air, which abounding in a chrystal, more than a diamond, maketh that lighter and rarer than this, by the more vacuities that are in the greater Quantity of air which is mingled with it.

But against this supposition, a powerfull adversary is urged: for *Aristotle*, in his 4. Book of physicks, hath demonstrated that there can be no motion in vacuity. It is true, they endeavour to evade his demonstration (as not reaching home to their supposition) by acknowledging it to be an evident one in such a vacuity as he there speaketh of; which he supposed to be so great a one that a body may swim in it as in an ocean, and not touch or be near any other body: whereas this opinion excludeth all such vast inanitie, and admitteth no vacuities but so little ones as no body whatsoever can come unto but will be bigger than they; and consequently, must on some side or other touch the corporal parts which those vacuities divide; for they are the separations of the least parts, that are, or can be, actually divided from one another: which parts must of necessitie touch one another on some side; or else they could not hang together to compose one substance; and therefore, the dividing vacuities, must be less than the divided parts. And thus, no body will ever be in danger of floating up and down without touching any thing: which is the difficulty that *Aristotle* chiefly impugneth.

I confess I should be very glad that this supposition might serve our turn, and save the *Phænomena* that appear among bodies through their variety of Rarity and Density: which if it might be, then would I straight go on to the inquiring after what followed out of this ground, as Astronomers (to use our former similitude) do calculate the future appearances of the celestial bodies out of those motions and orbs they assign unto the heavens. For as the apprehension of vacuity in bodies is very easie and intelligible: so the other (which I conceive to be the truth of the case) is exceedingly abstracted, and one of the most difficult points in all the metaphysicks: and therefore I would (if it were possible) avoid touching upon it in this discourse, which I desire should be as plain and easie, and as much removed from scholastick terms, as may be.

7.

The opinion of vacuities refuted.

But indeed, the inconveniences that follow out of this supposition of vacuities, are so great, as it is impossible by any means to slide them over. As for example; let us borrow of *Galileus* the proportion of weight between water and air. He sheweth us how the one is 400. times heavier than the other. And *Marinus Ghetaldus* teacheth us that gold is 19. times heavier than water: so that gold must be 7600 times heavier than air. Now then considering that nothing in a body can weigh, but the solid parts of it; it followeth, that the proportion of the parts of gold in a sphere of an inch diameter, is to the parts of air of a like dimension as 7600 is to one. Therefore in air itself the vacuities that are supposed in it, will be to the solid parts of it in the same proportion as 7600 to one. Indeed, the proportion of difference will be greater: for even in gold many vacuities must be admitted; as appeareth in the heating of it, which sheweth that in every the least part it is exceeding porous. But according to this rate, without pressing the inconvenience any further; the air will by this reckoning appear to be like a net, whose holes and distances, are to the lines and threads, in the proportion of 7600 to one; and so, would be lyable to have little parts of its body swim in those greater vacuities; contrary to what they strive to avoid, which would be exceedingly more, if we found on the one side any bodies heavier and denser than gold, and that were so solid as to exclude all vacuities; and on the other side should balance them with such

Archimed., Promot.

bodies

bodies as are lighter and rarer than air ; as fire is , and as some will have the *ether* to be. But already the disproportion is so great, and the vacuity so strangely exceedeth the body in which it is, as were too great an absurdity to be admitted.

And besides, it would destroy all motion of small bodies in the air, if it be true (as *Aristotle* hath demonstrated in the fourth book of his physicks) that motion cannot be made but among bodies, and not *in vacuo*.

Again, if rarity were made by vacuity, rare bodies could not be gathered together, without losing their rarity and becoming dense. The contrary of which, we learn by constant experience ; as when the smith and glass-mender drive their white and fury fires, (as they term them ;) when air pierceth most in the sharp wind : and generally we see that more of the same kind of rare bodies , in less place , worketh most efficaciously according to the nature that resulteth out of that degree of rarity. Which argueth , that every little part is as rare as it was before (for else it would lose the virtue of working according to that nature ;) but that by their being crowded together, they exclude all other bodies that before did mediate between the little parts of their main body ; and so , more parts being gotten together in the same place than formerly there were, they work more forcibly.

Thirdly, if such vacuities were the cause of rarity, it would follow, that fluid bodies being rarer than solid ones, they would be of themselves standing , like nets or cobwebs : whereas contrariwise, we see their natures are to run together, and to fill up every little creek and corner : which effect, following out of the very nature of the things themselves, must needs exclude vacuities out of that nature.

And lastly, if it be true (as we have shewed in the last Chapter) that there are no actual parts in Quantity ; it followeth of necessity, that all Quantity must of it self be one ; as Metaphysicks teach us : and then, no distance can be admitted between one Quantity and another.

And truly, if I understand *Aristotle* right , he hath perfectly demonstrated that no vacuity is possible in nature ; neither great nor little : and consequently, the whole machine raised upon that supposition, must be ruinous. His argument is to this purpose:

purpose: What is nothing, cannot have parts: but vacuum is nothing (because as the adversaries conceive it, vacuum is the want of a corporeal substance in an enclosing body; within whose sides nothing is, whereas a certain body might be contained within them, as if in a pail or bowl of a gallon, there were neither milk, nor water, nor air, nor any other body whatsoever) therefore, vacuum cannot have parts. Yet those who admit it do put it expressly for a space; which doth essentially include parts. And thus they put two contradictories, nothing and parts, that is, parts and no parts; or something and nothing, in the same proposition. And this, I conceive to be absolutely unavoidable.

For these reasons therefore, I must intreat my Readers favour, that he will allow me to touch upon metaphysics a little more than I desire or intended: but it shall be no otherwise, than as is said of the dogs by the river *Nilus* side; who being thirsty, lap hastily of the water, onely to serve their necessity as they run along the shore. Thus then; remembring how we determined that Quantity is Divisibility: it followeth, that if besides Quantity there be a substance or thing which is divisible; that thing if it be distinguished from its Quantity or Divisibility, must of it self be indivisible: or (to speak more properly) it must be, not divisible. Put then such substance to be capable of the Quantity of the whole world or universe; and consequently, you put it of it self indifferent to all, and to any part of Quantity: for in it, by reason of the negation of Divisibility, there is no variety of parts, whereof one should be the subject of one part of Quantity, or another of another; or that one should be a capacity of more, another of less.

This then being so, we have the ground of more or less proportion between substance and quantity: for if the whole quantity of the universe be put into it, the proportion of Quantity to the capacity of that substance, will be greater than if but half that Quantity were imbibed in the same substance. And because proportion changeth on both sides by the single change of only one side: it followeth, that in the latter, the proportion of that substance to its Quantity, is greater; and that in the former, it is less; howbeit the substance in it self be indivisible.

8.

Rarity and
Density consist
in the several
proportions,
which Quantity
hath to its sub-
stance.

What

What we have said thus in abstract, will sink more easily into us if we apply it to some particular bodies here among us, in which we see a difference of Rarity and Density; as to air, water, gold, or the like; and examine if the effects that happen to them, do follow out of this disproportion between substance and Quantity. For example, let us conceive that all the Quantity of the world were in one uniform substance, then the whole universe would be in one and the same degree of Rarity and Density: let that degree, be the degree of water; it will then follow, that in what part soever there happeneth to be a change from this degree, that part will not have that proportion of quantity to its substance, which the quantity of the whole world had to the presupposed uniform substance. But if it happeneth to have the degree of rarity which is in the air, it will then have more quantity in proportion to its substance, than would be due unto it according to the presupposed proportion of the quantity of the universe to the foresaid uniform substance; which in this case is as it were the standard to try all other proportions by. And contrariwise, if it happeneth to have the degree of Density which is found in the earth or in gold; then it will have less quantity in proportion to its substance, than would be due unto it according to the foresaid proportion, or common standard.

Now to proceed from hence, with examining the effects which result out of this compounding of Quantity with substance, we may first consider, that the definitions which Aristotle hath given us of Rarity and Density, are the same we drive at: he telleth us that that body is rare whose quantity is more, and its substance less; that, contrariwise dense, where the substance is more and the quantity less. Now if we look into the proprieties of the bodies we have named, or of any others, we shall see them all follow clearly out of these definitions. For first, that one is more diffused, another more compacted; such diffusion and compaction seem to be the very natures of Rarity and Density, supposing them to be such as we have defined them to be; seeing that substance is more diffused by having more parts, or by being in more parts; and is more compacted by the contrary. And then, that rare bodies are more divisible than dense ones, you see is coincident into the same conceit with their diffusion and compaction. And from hence again it followeth,

loweth, that they are more easily divided in great, and likewise, that they are by the force of natural Agents divisible into lesser parts: for both these (that is, facility of being divided, and easie divisibility into lesser parts) are contained in being more divisible, or in more enjoying the effect of quantity, which is divisibility. From this again followeth, that in rare bodies there is less resistance to the motion of another body through it, than in dense ones; and therefore a like force passeth more easily through the one, than through the other. Again, rare bodies are more penetrative and active than dense ones; because being (by their over proportion of quantity) easily divisible into smal parts, they can run into every little pore, and so incorporate themselves better into other bodies, than more dense ones can. Light bodies likewise must be rarer, because most divisible, if other circumstances concur equally.

Thus you see d. cyphered unto your hand, the first division of bodies flowing from Quantity as it is ordained to substance for the composition of a body: for since the definition of a body is, *A thing which hath parts*; and quantity is that, *by which it hath parts*; and the first propriety of quantity is, *to be bigger or lesse*; and consequently the first differences of having parts, are to have bigger or lesse, more or fewer; what division of a body can be more simple, more plain, or more immediate, than to divide it by its Quantity, as making it have bigger or lesse, more or fewer parts in proportion to its substance?

Neither can I justly be blamed for touching thus on Metaphysics, to explicate the nature of these two kinds of bodies; for Metaphysics being the Science above Physicks, it belongeth unto her to declare the principles of Physicks: of which, these we have now in hand, are the very first step. But much more, if we consider that the composition of quantity with substance, is purely Metaphysical; we must necessarily allow the inquiry into the nature of Rarity and Density, to be wholly Metaphysical; seeing that the essence of Rarity and Density standeth in the proportion of quantity to substance; if we believe *Aristotle*, (the greatest Master that ever was, of finding out Definitions and Notions) and trust to the uncontrollable reasons we have brought in the precedent discourse.

This explication of Rarity and Density, by the composition
of

All must admit
in Physical bo-
dies, a Meta-
physical com-
position.

of substance with quantity, may peradventure give little satisfaction unto such as are not used to raise their thoughts above Physical and natural speculations; who are apt to conceive there is no other composition or resolution, but such as our senses shew us in compounding and dividing of bodies according to quantitative parts. Now this obligeth us to shew that such a kinde of composition and division as this must necessarily be allowed of, even in that course of doctrine which seems most contrary to ours. To which purpose, let us suppose that the position of *Democritus* or of *Epicurus* is true; to wit, that the original composition of all bodies, is out of very little ones of various figures; all of them indivisible, not Mathematically, but Physically: and that this infinite number of indivisibles, doth float in an immense ocean of *vacuum* or imaginary space. In this position, let any man who conceiveth their grounds may be maintained, explicate how one of these little bodies is moved. For taking two parts of *vacuum*, in which this body successively is; it is clear, that really, and not onely in my understanding, it is a difference in the said body to be now here now there: wherefore when the body is gone thither, the notion of being here is no more in the body; and consequently is divided from the body. And therefore when the body was here, there was a composition between the body and its being here; which seeing it cannot be betwixt two parts of Quantity, must of necessity be such a kinde of composition, as we put between quantity and substance. And certainly, let men wrack their brains never so much, they will never be able to shew how motion is made, without some such composition and division, upon what grounds soever they proceed.

And if then they tell us, that they understand not how there can be a divisibility between substance and quantity; we may reply, that to such a divisibility two things are required; first, that the notions of substance and quantity be different; secondly, that the one of them may be changed without the other. As for the first, it is most evident we make an absolute distinction between their two notions; both when we say that *Socrates* was bigger a man than a boy; and when we conceive that milk or water whiles it boileth, or wine whiles it worketh, so as they run over the vessels they are in, are greater, and possess

possess more place than when they were cool and quiet, and filled not the vessel to the brim. For howsoever witty explanations may seem to evade, that the same thing is now greater now less; yet it cannot be avoided, but that ordinary men who look not into Philosophy, do both conceive it to be so, and in their familiar discourse expresse it so; which they could not do, if they had not different notions of the substance, and of the quantity of the thing they speak of. And though we had no such evidences, the very names and definitions of them would put it beyond strife: all men calling substance, a thing; quantity, bigness: and referring a thing to *Being*; as who would say, that which is: but bigness to some other of like nature, unto which it is compared; as, that it is half as big, twice as big, or the like.

This then being unavoidable, that the notions are distinguished; there remaineth no difficulty but onely in the second, namely that the one may be changed, and the other not. Which reason and demonstration do convince, as we have shewed. Wherefore if any shall yet further reply, that they do not understand how such change is made; we shall answer, by asking them whether they know how the change of being sometimes here sometimes there is made by local motion in *vacuum*, without a change in the body moved. Which question if they cannot satisfie, they must either deny that there is any local motion in *vacuum*; or else admit a change in quantity without a change in substance; for this latter is as evidently true, as they suppose the former to be; though the manner how they are effected be alike obscure in both, and the reason of the obscurity the same in both.

With which we will conclude the present Chapter; adding onely this note: That if all Physical things and natural changes do proceed out of the constitution of rare and dense bodies in this manner as we do put them, (as the work we have in hand intendeth to shew) then, so manifold effects will so convince the truth of this doctrine which we have declared, that there can remaine no doubt of it: neither can there be any of the divisibility of quantity from substance; without which this doctrine cannot consist. For it cannot be understood, how there is a greater proportion of quantity than of substance;

stance; or contrariwise, of substance than of quantity; if there be not real divisibility between quantity and substance. And much less can it be conceived, that the same thing hath at one time a greater proportion of quantity, and at another time a lesse, if the greater or lesser proportion be not separable from it; that is, if there be not a divisibility betwixt it and substance, as well as there are different notions of them. Which to prove by the proper principles belonging to this matter, would require us to make a greater inroad into the very bowels of Metaphysicks, and to take a larger circuit than is fitting either for the subject, or for the intended brevity of this Treatise.

CHAP. IV.

Of the four first qualities: and of the four Elements.

I. **T**He subject of our Discourse hitherto hath been three simple notions; Quantity, Rarity, and Density. Now it shall be to enquire if by compounding these with gravity or weight (which is one of the specieses of Quantity above mentioned, and of which I shall speak at large hereafter) we may beget any farther qualities, and so produce the four first bodies called Elements. In imitation of Logicians, who by compounding such Propositions as of themselves are evident to mans nature as soon as they are proposed, do bring forth new knowledges: which threds they still entermix and weave together, till they grow into a fair piece. And thus the Sciences they so much labour for, and that have so great an extent, do result out of a few and simple notions in their beginnings.

The notions of density and rarity have a latitude capable of infinite variety.

But before we fall to mingling and comparing them together, I think it will not be amisse to set down and determine what kinde of things we mean by rare, and what by dense; to the end that when the names are agreed upon, we may slip into no errour by mistaking them. So then, although there be several considerations, in regard of which, rarity and density may be differently attributed to bodies: yet because mans discerning them, to be able to discourse accordingly of them, is the principal respect for which their denominations are to be allotted them,

we

we may with reason call those things dense, wherein a man findeth a sensible difficulty to part them; and those rare, where the resistance is imperceptible.

And unto these two notions of rarity and density, we must allow a great latitude, far from consisting in an indivisible state; for seeing that rarefaction maketh a lesser body equal to a bigger; and that all inequality betwixt two bodies, hath the conditions of a body; it followeth that the excessse of one body over another, consisteth of infinite parts into which it might be divided: and consequently, that what is rarified, passeth as many degrees as the inequality or excessse hath parts. And the same law being in condensation, both dense and rare things must be acknowledged to be capable of infinite variety, and diversity of states in regard of more and lesse in the same kinde.

These things being premised; and calling to minde that it is the nature of density to make the parts of a dense thing compact, and stick together, and be hardly divisible; and on the contrary side, that it is the nature of rarity, to diffuse and extend a rare thing, and to prepare and approach it to division, according to the proportion of the degree of rarity which it hath; and that weight doth abound where there is excessse of density, and is very little or none in excessse of rarity: we may now begin in our imagination to put these qualities into the scales one against another, to see what effects they produce in bodies. And first, let us weigh gravity against density or sticking together of parts: which sticking or compactedness being natural to density, requireth some excessse of gravity in proportion to the density, or some other outward violence, to break it. If then in a dense body the gravity overcome the density, and do make the parts of it break asunder, it will draw them downwards towards the center that gravity tendeth unto, and will never let them rest till they come thither, unlesse some impediment meet them by the way and stop their journey: so that such a body will, as neer as possibly it can, lie in a perfect spherical figure in respect of the center; and the parts of it will be changed and altered, and thrust on any side that is the ready way thither; so that by the force of gravity working upon it, it will run as far as it meeteth with nothing to hinder it from

C

attaining

2.
How moistness
and dryness
are begotten
in dense bo-
dies.

attaining this spherichal superficies. Wherefore such bodies, for the most part, have no settled outside of their own; but do receive their figure and limits from such lets as hinder them from attaining to that sphericallness they aim at.

Now *Aristotle* (whose definitions, are in these matters generally received, as fully expressing the notions of mankind) telleth us, and our own experience confirmeth it, that we use to call those things *moist*, which run in such sort as we have here set down; and that we term those things *dry*, which have a consistence within themselves; and which to enjoy a determinate figure, do not require the stop or hinderance of another body to limit and circle them in: which will be the nature of those that have a greater proportion of density in respect of their gravity.

And thus, out of the comparison of density with weight, we have found two more qualities than we yet had met withall, namely wetness and dryness. For although a body be dense, (which of its own nature, singly considered, would preserve the continuity of its parts, as making the body hardly divisible, whereby it would be dry) yet if the gravity that worketh upon it, be in proportion greater than the density, it will sever the parts of it, and make them run to the center, and so become fluid and moist: though not in the eminentest degree that may be of fluidity and moisture; by reason that if the like overproportion of gravity happen in a rare body, it will there more powerfully work its effect, than it can in a dense body; because a rare body will more easily obey, and yield to the gravity that mastereth it, than a dense one will; and consequently, will be more fluid and moist than it.

3. Now on the other side, in weighing rarity against gravity; it
 How moistness and dryness are begotten in rare bodies. it happen that the rarity overcome the gravity, then the gravity will not change the figure of a body so proportioned, but what figure it hath from its proper natural causes, the same will still remain with it: and consequently, such a body will have terms of its own, and will not require an ambient body to limit, and circle it in: which nature, we call dry.

But if the proportion of the gravity be the greater, and do overcome the rarity; then, by how much the rarity is greater, so much the more will the gravity force it, to apply it self equally

ly and on all sides to the center : and such a body will the more easily receive its figure from another, and will be lesse able to consist of it self : which properties, we attribute to wetnesse or moisture. So that it appeareth how the qualities of wet and dry, which first we found in things that were dense, are also common to that nature of bodies, which we term rare.

And thus, by our first inquiry after what kinde of bodies do result out of the compounding of rarity and density with gravity, we discover four different sorts: some dense ones that are dry, and others likewise dense that are moist : then again, some rare ones that are likewise moist, and other rare ones that are dry.

But we must not rest here : let us proceed a little farther, to search what other properties these four kindes of bodies will have ; which we shall best discover, if we apply them severally to some other compounded body (of which Nature, are all those we converse with or see) and then consider the effects which these do work upon it. To begin with that, which we said is so excessively rare that gravity hath no power over it. If we look upon the multitude of little parts it may be divided into, whereof every one will subsist by it self (for we have already proved it dry) and then suppose them to be moved with force and strength against the body we apply them to : it must necessarily follow, that they will forcibly get into the porousnesse of it, and passe with violence between part and part, and of necessity separate the parts of that thing one from another ; as a knife or wedge doth a solid substance, by having their thinnest parts pressed into it : so that if in the compounded thing, some parts be more weighty, others more light, (as of necessity there must be) the heaviest will all fall lowest, the lightest will fly uppermost, and those which are of a mean nature between the two extremes, will remain in middle. In sum, by this action of an extreme rare body upon a compounded one, all the parts of one kinde that were in the compounded one, will be gathered into one place ; and those of divers kindes into divers places : which is the notion whereby *Aristotle* hath expressed the nature of heat ; and is an effect, which daily experience in burning and boiling, teacheth us to proceed from heat. And therefore we cannot doubt, but that such extreme rare bodies are as well hot as dry.

4.

Heat is a property of rare bodies, and cold of dense ones.

On the other side, if a dense thing be applyed to a compound, it will (because it is weighty) presse it together: and if that application be continued on all sides, so that no part of the body that is pressed be free from the siege of the dense body that presseth it, it will form it into a narrower room, and keep in the parts of it, not permitting any of them to slip out. So that what things soever it findeth within its power to master, be they light or heavy, or of what contrary natures soever, it compresseth them as much as it can, and draweth them into a lesse compasse, and holdeth them strongly together, making them stick fast to one another. Which effect, Aristotle took for the proper notion of cold; and therefore gave for definition of the nature of it, *that it gathereth things of divers natures*: and experience sheweth us in freeing, and all great coolings, that this effect proceedeth from cold.

5.
Of the two
dense bodies,
the lesse dense
is more cold:
but of the two
rare ones, the
lesse rare is
lesse hot.

But if we examine which of the two sorts of dense bodies (the fluide or the consistent) is most efficacious in this operation; we shall finde, that the lesse dense one is more capable of being applyed round about the body it shall besiege; and therefore will stop closer every little hole of it, and will more easily send subtile parts into every little vein of it; and by consequence, shrink it up together, and coagulate, and constringe it more strongly, than a body can that is extremely dense; which by reason of its great density, and the stubbornesse of its parts, cannot so easily bend and plie them to work this effect. And therefore, a body that is moderately dense is colder then another that is so in excess; seeing that cold is an active or working power, and that which is lesse dense doth excell in working.

On the contrary side, rare bodies being hot, because their subtile parts environing a compounded body will sink into the pores of it, and to their power separate its parts; it followeth, that those wherein the gravity overcometh the rarity, are lesse hot than such others as are in the extremity, and highest excessse of rarity: both, because the former are not able to pierce so little parts of the resisting dense body, as extreme rare ones are; and likewise, because they more easily take ply by the obstacle of the solid ones they meet with, than these do.

So

So that out of this discourse we gather, that of such bodies that differ precisely by the proportion of Rarity and Density; those which are extremely rare, are in the excess of heat, and are dry withall: that weighty rare bodies are extremely humide, and meanly hot: that fluide dense bodies are moist, though not in such excess as rare ones that are so; but are coldest of any: and lastly, that extreme dense bodies are less cold than fluid dense ones, and that they are dry.

But whether the extreme dense bodies be more or less dry than such as are extremely rare, remaineth yet to be decided. Which we shall easily do, if we but reflect that it is density which maketh a thing hard to be divided, and that rarity maketh it easie: for a facility to yield unto division, is nothing else but a plyableness in the thing that is to be divided, whereby it easily receiveth the figure, which the thing that divideth it doth cast it into. Now this plyableness belongeth more to rare than to dense things: and accordingly, we see fire bend more easily, by the concameration of an oven, than a stone can be reduced into due figure by hewing. And therefore, since dryness is a quality that maketh those bodies wherein it reigneth, to conserve themselves in their own figure and limits, and to resist the receiving of any from another body; it is manifest that those are driest, wherein these effects are most seen; which is, in dense bodies: and consequently, excess of dryness must be allotted unto them, to keep company with their moderate coldness.

6.

The extreme dense body is more dry, than the extreme rare one.

Thus we see that the number of Elements assigned by Aristotle is truly and exactly determined by him; and that there can be neither more nor less of them; and that their qualities are rightly allotted to them: which to settle more firmly in our mindes, it will not be misse-spent time to summe up in short the effects of what we have hitherto said to bring us unto this conclusion. First, we shewed that a body is made, and constituted a body by quantity. Next, that the first division of bodies is into rare and dense ones; as differing onely by having more and less quantity. And lastly, that the conjunction of gravity with these two, breedeth two other sorts of combinations: each of which is also twofold; the first sort, concerning rarity; out of which ariseth one extremely hot and moderately dry, and another

7.

There are but four simple bodies: and these are rightly named Elements

other extremely humid and moderately hot; the second sort, concerning density; out of which, is produced one that is extremely cold and moderately wet, and another extremely dry and moderately cold. And these are the combinations whereby are constituted fire, air, water, and earth.

So that we have thus, the proper notions of the four Elements; and have both them and their qualities driven up and resolved into their most simple principles: which are, the notions of *Quantity*, and of the two most simple differences of quantitative things, *Rarity* and *Density*. Beyond which, mans wit cannot penetrate; nor can his wishes aim at more in this particular: seeing he hath attained to the knowledge of what they are, and of what maketh them be so, and that it is impossible they should be otherwise: and this, by the most simple and first principles, which enter into the composition of their nature. Out of which it is evident, that these four bodies are *Elements*: since they cannot be resolved into any others, by way of Physical composition; themselves being constituted by the most simple differences of a body. And again, all other bodies whatsoever must of necessity be resolved into them, for the same reason; because no bodies can be exempt from the first differences of a body. Since then, we mean by the name of an *Element*, *a body not composed of any former bodies, and of which all other bodies are composed*, we may rest satisfied that these are rightly so named.

8. But whether every one of these four Elements, do comprehend under its name one onely lowest species or many (as, whether there be one onely species of fire, or several; and the like of the rest) we intend not here to determine. Yet we note, that there is a great latitude in every kinde; seeing that, *Rarity* and *Density* (as we have said before) are as divisible as quantity. Which latitudes, in the bodies we converse withall, are so limited, that what maketh it self and other things be seen (as being accompanied by light) is called fire. What admitteth the illuminative action of fire, and is not seen, is called air. What admitteth the same action, and is seen (in the rank of Elements) is called water. And what through the density of it admitteth not that action, but absolutely reflecteth it, is called earth.

The Author doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.

And

And out of all we said of these four Elements, it is manifest there cannot be a fifth : as is to be seen at large in every Aristotelian Philosopher that writeth of this matter. I am not ignorant that there are sundry objections used to be made, both against these notions of the first qualities, and against the division of the Elements : but because they, and their solutions, are to be found, in every ordinary Philosopher ; and that they be not of any great difficulty ; and that the handling them, is too particular for the design of this discourse, and would make it too prolix ; I refer the Reader to seek them, for his satisfaction, in those Authors that treat Physicks professedly, and have delivered a compleat body of Philosophy.

And I will end this Chapter with advertising him (lest I should be misunderstood) that though my disquisition here hath pitched upon the four bodies of fire, air, water, and earth ; yet it is not my intention to affirm, that those which we ordinary call so, and do fall daily within our use, are such as I have here expressed them : or that these Philosophical ones (which arise purely out of the combination of the first qualities) have their residence or consistence in great bulks, in any places of the world, be they never so remote : as fire, in the hollow of the Moons orb ; water, in the bottom of the sea ; air, above the clouds ; and earth below the mines. But these notions are onely to serve for certain Ideas of Elements ; by which, the four named bodies, and the compounds of them, may be tryed and receive their doom of more or less : pure and approaching to nature from whence they have their denomination. And yet I will not deny, but that such perfect Elements may be found in some very little quantities, in mixed bodies : and the greatest abundance of them, in these four known bodies that we call in ordinary practice, by the names of the pure ones : for they are least compounded, and approach most to the simpleness of the Elements. But to determine absolutely their existence, or not existence, either in bulk or in little parts, dependeth of the manner of action among bodies : which as yet we have not meddled with.

CHAP. V.

Of the operations of the Elements in general; And of their activities compared with one another.

I.
The first operation of the Elements is division, out of which resulteth local motion.

HAVING by our former discourse inquired out what degrees and proportions of rarity and density compounded with gravity, are necessary for the production of the Elements, and first qualities, whose combinations, frame the Elements: our next consideration in that orderly progresse we have proposed unto our selves in this treatise (wherein our aim is, to follow successively the steps, which Nature hath printed out unto us) will be to examine the operations of the Elements, by which they work upon one another. To which end, let us propose to our selves a rare and a dense body encountering one another by the impulse of some exterior agent. In this case, it is evident, that since rarity implyeth a greater proportion of quantity, and quantity is nothing but divisibility, rare bodies must needs be more divisible than dense ones: & consequently, when two such bodies are pressed one against another; the rare body not being able to resist division so strongly, as the dense one is; and being not permitted to retire back, by reason of the extern violence impelling it against the dense body; it followeth, that the parts of the rare body must be severed, to let the dense one come between them: and so the rare body becometh divided, and the dense body the divider. And by this we see that the notions of divider and divisible do immediately follow rare and dense bodies; and do so much the more properly agree unto them, as they exceed in the qualities of Rarity and Density.

Likewise, we are to observe in our case, that the dense or dividing body must necessarily cut and enter farther and farther into the rare or divided body; and so the sides of it be joyned successively to new and new parts of the rare body that giveth way unto it, and forsake others it parteth from. Now the rare body being in a determinate situation of the universe, (which we call *being in a place*, and is a necessary condition belonging to all particular bodies) and the dense body coming to be within the rare body, whereas formerly it was not so: it followeth, that it loseth the place it had, and gaineth another. This effect, is that which we call local motion.

And

And thus we see, by explicating the manner of this action, 2.
that local motion is nothing else but the change of that respect ^{what place is;}
or relation, which the body moved hath to the rest of the uni- ^{both notional-}
verse, following out of Division: and the name of local moti- ^{ly and really.}
on, formally signifieth onely the mutation of a respect to other
extrinsecal bodier, subsequent to that division. And this is so
evident and agreeable to the notions that all mankind (who, as
we have said, is judge and master of Language) naturally fra-
meth of place, as I wonder much why any will labour to give
other artificial and intricate doctrine of this that in it self is so
plain and clear. What need is there to introduce an imagina-
ry space (or with *Joannes Grammaticus*, a subsistent quan-
tity) that must run through all the World; and then entail
to every body an airy entity, and unconceivable mood, an
unintelligible Ubi, that by an intrinsecal relation to such a part
of the imaginary space, must thereunto pin and fasten the bo-
dy it is in? It must needs be a ruinous Philosophy that is
grounded upon such a contradiction, as is the allotting of parts
unto that, which the Authors themselves (upon the matter) ac-
knowledge to be meerly nothing; and upon so weak a shift (to
deliver them from the inconveniencies that in their course of do-
ctrine other circumstances bring them unto) as is the volunta-
ry creating of new imaginary Entities in things, without any
ground in nature for them. Learned men should expresse the
advantage and subtilty of their wits, by penetrating farther
into nature, than the vulgar; not by vexing and wresting it
from its own course. They should refine and carry higher, not
contradict and destroy the notions of mankind, in those things
that it is the competent judge of: as it undoubtedly is of those
primary notions which *Aristotle* hath ranked under ten heads:
which (as we have touched before) every body can con-
ceive in grosse: and the work of Scholars is to explicate them
in particular; and not to make the vulgar believe th y are
mistaken, in framing those apprehensions that nature taught
them.

Out of that which hath been hitherto resolved it is manifest,
that place really, and abstracting from the operation of the un-
derstanding, is nothing else but the inward superficies of a body
that compasseth and immediately containeth another. Which
ordina

ordinarily being of a rare body that doth not shew it self unto us (namely, the air) is for the most part unknown by us. But because nothing can make impression upon our mind, and cause us to give it a name otherwise than by being known: therefore our understanding to make a compleat notion, must add something else to this fleeting and unremarkable superficies that may bring it unto our acquaintance. And for this end we may consider farther, that as this superficies hath in it self, so the body enclosed in it gaineth a certain determinate respect unto the stable and immovable bodies that environ it. As for example, we understand such a tree to be in such a place by having such and such respects to such a hill neer it, or to such a house that standeth by it, or to such a river that runneth under it, or to such an immovable point of the heaven that from the Suns rising in the Equinox is called East, and such like. To which purpose, it importeth not whether these that we call immovable bodies and points be truly so, or do but seem so to mankind. For man talking of things according to the notions he frameth of them in his minde (speech being nothing else but an expression to another man, of the images he hath within himself) and his notions being made according to the seeming of the things, he must needs make the same notions, whether the things be truly so in themselves, or but seem to be so, when that seeming or appearance is alwaies constantly the same.

3.
Local motion
is that division
whereby a body
changeth
its place.

Now then when one body dividing another getteth a new immediate clothing; and consequently new respects to the stable and immovable bodies (or seeming such) that environ it; we do vary in our selves the notion we first had of that thing; conceiving it now accompanied with other circumstances and other respects than formerly it had. Which notion we expresse by saying, it hath changed its place, and is now no longer where it was at the first. And this change of place we call *Local motion*: to wit, the departing of a body from that hollow superficies which inclosed it; and its changing unto another, whereby it gaineth new respects to those parts of the world that have, or in some sort may seem to have immobility and fixed stableness. So as hence it is evident, that the substance of local motion consisteth in division; and that the alteration of Locality followeth division; in such sort as becoming like or unlike of one wall to

to another, followeth the action whereby one of them becometh white.

And therefore in nature we are not to seek for any entity or special cause of applying the moved body to a place as place, (which is but a respect consequent to the effect of division) but onely to consider what real and Physical action uniteth it to that other body, which is called its place, and truly serveth for that effect. And consequently, they who think they have discovered a notable subtilty by bringing in an Entity to unite a body to its place, have strained beyond their strength, and have grasped but a shadow; which will appear yet more evident, if they but mark well how nothing is divisible but what of it self (abstracting from division) is one. For the nature of division is the making of many; which implyeth, that what is to be divided must of necessity be not many before it be divided. Now quantity being the subject of division, it is evident that purely of it self and without any force or adjoynd helps, it must needs be one, wheresoever some outward agent doth not introduce multiplicity upon it. And whensoever other things work upon quantity as quantity, it is not the nature and power of their operation to produce unity in it and make it one; for it is already one: but contrariwise, the immediate necessary effect that floweth from them in this case, is to make one quantity many, according to the circumstances that accompany the divider, and that which is to be divided. And therefore, although we may seek causes why some one thing sticketh faster together than some other, yet to ask absolutely why a body sticketh together, were prejudicial to the nature of quantity; whose essence is to have parts sticking together, or rather to have such unity, as without it all divisibility must be excluded.

Out of which discourse it followeth, that in local motion we are to look onely for a cause or power to divide, but not for any to unite. For the very nature of quantity uniteth any two parts that are indistant from one another, without needing any other cement to glew them together: as we see the parts of water and all liquid substances, do presently unite themselves to other parts of like bodies when they meet with them, and to solid bodies if they chance to be next unto them. And therefore it is vain to trouble our heads with Unions and imagin-
ry

4.

The nature of quantity of it self is sufficient to unite a body to its place.

ry Moods to unite a body to the place it is in, when their own nature maketh them one as soon as they are immediate to each other. And accordingly, if when we see a boul move, we would examine the causes of that motion, we must consider the quantity of air or water it maketh to break from the parts next unto it, to give place unto it self: and not speculate upon an intrinsecal relation from the body to a certain part of the imaginary space they will have to run through all things. And by ballancing that quantity of air or water which it divideth, we may arrive to make an estimate of what force the boul needeth to have for its motion.

5. Thus having declared that the locality of motion is but an extrinsecal denomination, and no reality in the thing moved; we may now cast an eye upon a vast consequence that may be deduced out of what we have hitherto said. For if we consider the nature of a body, that is, that a body is a body by quantity; and that the formal notion of quantity is nothing else but divisibility; and that the adequate act of divisibility is division: it is evident there can be no other operation upon quantity, nor (by consequence) among bodies, but must either be such division as we have here explicated, or what must necessarily follow out of such division. And division (as we have even now explicated) being local motion; it is evident that all operations among bodies are either local motion, or such as follow out of local motion. Which conclusion, howsoever unexpected, and may at the first hearing appear a Paradox, will neverthelesse by the ensuing work receive such evidence as it cannot be doubted of; and that not onely by force of argumentation and by necessity of notions (as is already deduced) but also by experience, and by declaration of particulars as they shall occur.

6. But now to apply what we have said to our proposed subject: it is obvious to every man, that seeing the divider is the agent in division and in local motion; and that dense bodies are by their nature dividers; the earth must in that regard be the most active among the Elements, since it is the most dense of them all. But this seemeth to be against the common judgement or all the searchers of nature, who unanimously agree that fire is the most active Element. As also it seemeth to impugn what we
our

All operations among bodies, are either local motion, or such as follow out of local motion.

Earth compared to water in activity.

our selves have determined, when we said, there were two active qualities, heat and cold, whereof the first was in its greatest excess in fire, and the latter in water.

To reconcile these, we are to consider that the action of cold in its greatest height is composed of two parts; the one is a kinde of pressing, and the other is penetration which requireth applicability. Of which two the former ariseth out of density, but the latter out of moderation of density, as I have declared in the precedent Chapter. Wherefore the former will exceed more in earth, though the whole be more eminent in water. For though considering onely the force of moving (which is a more simple and abstracted notion, than the determination and particularization of the Elements, and is precedent to it) therein earth hath a precedency over water: yet taking the action as it is determined to be the action of a particular Element, and as it concurrereth to the composition or dissolution of mixed bodies; in that consideration (which is the chief work of Elements, and requireth an intime application of the Agents) water hath the principality and excess over earth.

§. 6.

As for fire it is more active than either of them; as it will appear clearly if we consider, how when fire is applied to fiewell, and the violence of blowing is added to its own motion, it incorporateth it self with the fiewell, and in a small time converteth a great part of it into its own nature, and shattereth the rest into smook and ashes. All which proceedeth from the exceeding smallness and drynesse of the parts of fire; which being moved with violence against the fiewell, and thronging in multitudes upon it; they easily pierce the porous substance of it, like so many extreme sharp needles.

7.

The manner whereby fire getteth into fiewell, proveth that it exceedeth earth in activity.

And that the force of fire is as great and greater than of earth, we may gather out of our former discourse; where having resolved that density is the virtue by which a body is moved and doth cut the *medium*; and again considering that celerity of motion, is a kinde of density, (as we shall by and by declare) it is evident, that since blowing must of necessity presse violently and with a rapid motion, the parts of fire against the fiewell, and so condense them exceedingly there, (both by their celerity, and by bringing very many parts together there;) it must needs

needs also give them activity and virtue to pierce the body they are beaten against.

Now, that celerity is a kinde of density, will appear by comparing their natures. For if we consider that a dense body may be dilated so as to possesse and fill the place of a rare body that exceeded it in bignesse; and by that dilatation, may be divided into as many and as great parts as the rare body was divisible into; we may conceive that the substance of those parts, was by a secret power of nature folded up in that little extension in which it was before. And even so, if we reflect upon two Rivers of equal channels and depths, whereof the one goeth swifter than the other; and determine a certain length of each channel, and a common measure of time: we shall see that in the same measure of time, there passeth a greater bulk of water in the designed part of the channel of the swifter stream, than in the designed part of the slower, though those parts be equal.

Neither doth it import, that in velocity we take a part of time, whereas in density it seemeth that an instant is sufficient; and consequently, there would be no proportion between them. For knowing Philosophers do all agree that there are no instants in time, and that the apprehension of them proceedeth incerly from the manner of our understanding. And as for parts in time, there cannot be assumed any so little, in which the comparison is not true: and so in this regard, it is absolutely good.

And if the Reader have difficulty at the disparity of the things which are pressed together in density and in celerity; for that in density there is onely substance, and in celerity there is also quantity, crowded up with the substance; he will soon receive satisfaction, when he shall consider that this disparity is to the advantage of what we say, and maketh the nature of density more perfect in celerity, and consequently more powerfull in fire than in

8. The same is earth. Besides, if there were no disparity, it would not be a distinct species of density, but the very same. By what we have spoken above, it appeareth how fire getteth into fewel; now let us consider how it cometh out: for the activity of that fierce body will not let it lie still and rest, as long as it hath so many enemies round about it to rouse it up. We see then that as soon as it hath incorporated it self with the fewel,

fewel and is grown master of it by introducing into it so many of its own parts, (like so many Souldiers, into an Enemies Town) they break out again on every side with as much violence as they came in. For by reason of the former resistance of the fewel; their continual streaming of new parts upon it, and one overtaking another there where their journey was stopped, (all which is encreased by the blowing) doth so exceedingly condense them into a narrower room than their nature affecteth, that as soon as they get liberty, and grow masters of the fewel, (which at the first was their prison) they enlarge their place, and consequently come out and flie abroad; ever aiming right forwards from the point where they begin their journey: for the violence wherewith they seek to extend themselves into a larger room, when they have liberty to do so, will admit no motion but the shortest, which is, by a straight line.

So that if in our phantasie, we frame an Image of a round body all of fire; we must withall presently conceive, that the flame proceeding from it, would diffule it self every way indifferently in straight lines; in such sort, that the source serving for the center, there would be round about it an huge sphear of fire and of light; unlesse some accidental and extern cause should determine its motion more to one part than to another. Which compass, because it is round, and hath the figure of a sphear, is by Philosophers termed the sphear of its activity.

So that it is evident, that the most simple and primary motion of fire, is a flux in a direct line from the center of it, to its circumference, taking the fewel for its center: as also, that when, it is beaten against a harder body, it may be able to destroy it, although that body be in its own nature more dense than fire. For the body against which it presseth, either hath pores, or hath none, (as, the Elements have none:) if it hath pores; then the fire, by reason of the violent motion of the impellent, driveth out the little bodies which fill up those pores, and succeeding in their room, and being multiplyed there, causeth those effects which in our discourse of the Elements we assigned to heat. But if it have no pores; it will be either rare or dense: if it be rare; then, in cause that the force of the impellent be
greater

greater than the resistance of the rare body, it will force the fire to divide the rare body. But if it be dense; as, some atom of earth; then, though at the first it cannot divide it; yet by length of time and by continual beating upon it, it may come to wear off some part of it, the force of the impellent by little and little bending the atom of the earth, by driving a continual stream of a lesser part of fire, against some determinate part of the atom. By which word *Atom*, nobody will imagine we intend to express a perfect indivisible, but onely, the least sort of natural bodies.

CHAP. VI.

Of Light: what it is.

I.
In what sense
the Author re-
jecteth quali-
ties.

HAVING said thus much of the fire; the neer relation that is between it and light, inviteth us in the next place to bend our eyes to that which useth to dazel theirs who look unwarily upon it. Certainly, as among all the sensible qualities, it is the principal; so among all corporeal things, it seemeth to aim rightest at a spiritual nature; and to come neerest unto it. And by some hath been judged to be spiritual; if our eyes be capable to see spirits. No meaner man than *Aristotle* leadeth the dance to hold light a quality, and mainly to deny it any bodily subsistence. And there hath followed him no fewer, than almost all the world ever since. And the Question importeth no less, than the whole doctrine of qualities; for admit light to be a body, and hardly any man will hold up his hand in defence of any other quality: but if it be a quality; then all others come in by parity and for company.

But before we go any farther, it will not be amisse to expresse what we mean when we reject qualities; and how, in some sense, we are content to admit them. According to that description that Philosophers ordinarily do make of them, (and especially the modern) we can by no means give way unto them. I confesse ingenuously, I understand not what they mean by them; and I am confident, that neither do they. For the very notion, that their first words seem to expresse of them, they contradict again, before they make an end of describing what they are. They will have them to be real

Entities

Entities or *Things*, distinct from the bodies they accompany: and yet, they deny them a subsistence or self-being; saying they do but inhere in their subject, which supporteth them; or which is all one, that their being is a dependence of a subject.

If they will reflect upon what they say, and make their thoughts and their words agree; they will finde, that the first part of their description maketh them compleat substances; which afterwards, in words they flatly deny: and it is impossible to reconcile these two meanings. A real Entity or thing must necessarily have an *Existence* or *Being* of its own: which they allow them. And whatsoever hath so, becommeth a substance: for it subsisteth by its own Existence; or (to say plainer) is what it is by its own Being; and needeth not the existence of another thing to give it a *Being*. And then presently to say that it doth not subsist of it self; or that it requireth the subsistence of a substance, to make it *Be*; is a pure contradiction to the former.

This ariseth from a wrong notion they make to themselves of substance, existence and subsistence: and from their not consulting sufficiently with their own thoughts, as well as studying in books. They meet there with different terms; by help of which, they keep themselves from contradiction in words, but not in effect. If the terms were rightly conceived, and notions duly fitted to them, (which requireth deep meditation upon the things themselves, and a brain free from all inclination to siding, or affection to opinions for the Authours sakes, before they be well understood and examined) many of those disputes would fall to the ground, in which oftentimes both sides lose themselves, and the question, before they come to an end. They are in the dark before they are aware: and then they make a noise, onely with terms; which like too heavy weapons that they cannot wield, do carry their strokes beyond their aim. Of such nature are the qualites and moods, that some modern Philosophers have so subtilised upon. And in that sense, we utterly deny them: which being a question appertaining to Metaphysicks, it belongeth not to our present purpose to engage our selves farther in it.

But, as they are ordinarily understood in common conversation,

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sation,

2.

In what sense
the Author
doth admit of
qualities.

sation, we allow them. And our work is but to explicate and shew the particulars in retail, of what men naturally speak in grosse. For that serveth their turn to know what one another meaneth: whereas, it belongeth onely unto a Philosopher, to examine the causes of things. Others are content with the effects: and they speak truly and properly when they design them. As for example, when they say that Fire burneth by a quality of heat that it hath, or that a Dye is square by the quality of a cubical figure that is in it; they speak as they should do. But if others will take occasion upon this, to let their understanding give a *Being* unto these qualities, distinct from the substances in which they conceive them; there they misse. If we consider the same man hungry, or thirsty, or weary, or sleepy, or standing, or sitting; the understanding presently maketh within it self reall things of sleep, hunger, thirst, wearinesse, standing, and sitting. Whereas indeed, they are but different affections or situations of the same body. And therefore we must beware of applying these notions of our minde, to the things as they are in themselves: as much as we must, of conceiving those parts to be actually in a continued quantity, whereof we can frame actually distinct notions in our understanding. But as, when ordinary men say, that a yard containeth three feet; it is true in this sense, that three feet may be made of it; but that whiles it is a yard, it is but one quantity or thing, and not three things: so, they who make profession to examine rigorously the meaning of words, must explicate in what sense it is true that heat and figure (our former examples) are qualities: for such we grant them to be; and in no wise do contradict the common manner of speech; which entereth not into the Philosophical nature of them.

We see then, that qualities are nothing else but the proprieties, or particularities wherein one thing differeth from another. And therefore Logicians call substantial differences, substantial qualities: and say, they are predicated in *Quale quid*. But the Predicament of *Quality* is ordered by Aristotle to conclude in it those differences of things, which are neither substantial nor quantitative, and yet are intrinsecal and absolute. And so that which the understanding calleth heat, and maketh a
notion

notion of, distinct from the notion of the fire from whence it issueth to burn the wood that is neer it; is nothing else, in the fire, but the very substance of it in such a degree of rarity; or a continual stream of parts issuing out of the main stock of the same fire, that entreteth into the wood, and by the rarity of it maketh its way through every little part, and divideth them. All which actions are comprised by the understanding under one notion of burning: and the power, (which is fire it self) to do these actions, under one notion of the quality of heat: though burning in effect, and explicated Philosophically, be nothing else but the continuance of those material motions we have even now described. In like manner, the cubical figure of a dye, is nothing else but the very body of the dye it self, limited by other bodies from being extended beyond those dimensions it hath: and so the quality of figure or squareness, which in common speech is said to be in it, is truly, the substance it self, under such a consideration as is expressed by that word.

But to come to our question, upon the decision of which dependeth the fate of all the fictitious Entities which in the Schools are termed qualities. The chief motives that perswade light to be one of those, may, to my best remembrance, be reduced to five several heads. The first is, that it illuminateth the air in an instant, and therefore cannot be a body: for a body requireth succession of time to move in: whereas, this seemeth to spread it self over the whole Hemisphear in an instant; for as farre as the Sunne is distant from us, he no sooner raiseth his head above our Horizon, but his darts are in our face: and generally, no imagination can be framed, of any motion it hath in its dilatation.

3.

Five arguments proposed to prove that light is not a body.

The next is; that whereas no body can admit another into its place, without being removed away it self, to leave that room unto the advenient one; neverthelesse, plain experience sheweth us daily, that two lights may be in the same place; and the first is so farre from going away at the coming of the second, that the bringing in of a second candle, and setting it neer the first, encreaseth the lights in the room; which diminisheth again when the second is removed away. And by the same reason, if light were a body, it should drive away the aire

(which is likewise a body) wheresoever it is admitted : for within the whole sphere of the irradiation of it, there is no point wherein one may set their eye, but light is found. And therefore, if it were a body, there would be no room for air in that place which light taketh up. And likewise, we see, that it penetrateth all solid bodies, (and particularly glass,) as experience sheweth, in wood, stone, metals, and any other body whatsoever, if it be made thin enough.

The third argument, why light cannot be a body, is, that if it were so, it can be none other but fire, which is the subtlest, and most rarified of all bodies whatsoever. But if it be fire, then it cannot be without heat : and consequently, a man could not feel cold in a sun shining day. The contrary of which is apparent all winter long ; whose brightest daies oftentimes prove the coldest. And *Galileus* with divers others since, did use from the sun to gather light in a kinde of stone that is found in *Italy* (which is therefore by them called, *la calamita della luce*) and yet no heat appeared in it. A glow-worm will give light to read by, but not to warm you any whit at all. And it is said, that Diamonds and Carbuncles will shine like fire in the greatest darks ; yet no man ever complained of being served by them as the foolish Satyre was by kissing of a burning coal. On the contrary side ; if one consider how great heats may be made without any light at all, how can one be perswaded that light and heat should be the same thing, or indeed any whit of kin ?

The fourth motive to induce us to believe that light cannot be a body, is the sudden extinction of it, when any solid body cometh between the fountain of it, and the place where he sendeth his beams. What becometh of that great expansion of light that shined all about, when a cloud interposeth it self between the body of the sun and the streams that come from it ? Or when it leaveth our horizon to light the other world ? His head is no sooner out of our sight ; but at the instant all his beams are vanished. If that which filleth so vast a room were a body, something would become of it : it would at least be changed to some other substance ; and some reliques would be left of it ; as when ashes remain of burned bodies : for nature admitteth not the annihilation of any thing.

And in the last place, we may conceive that if light were a body,

dy, it would be shaken by the winds, and by the motion of the air; and we should see it quaver in all blustering weather. Therefore summing up all we have said; it seemeth most improbable, and indeed wholly impossible; that light should be a body; and consequently, must have his place among qualities.

But on the other side; before we apply our selves to answer these objections, let us make a short survey of those inducements that prevaile with us to believe light a body, notwithstanding so forcible oppositions. I admit so far of the third argument, as to allow light to be fire: for indeed it cannot be imagined to be any thing else; all properties agreeing so fully between them. But withall I must add; that it is not fire in every form, or fire joyned with every substance, that expresseth it self by light; but it is fire extremely dilated, and without mixture of any other gross body. Let me hold a peice of Linen or paper close by the flame of a candle, and by little and little, remove it farther and farther off; and methinks my very eyes tell me, that there is upon the paper some part of that which I see in the candle; and that it groweth still less and less like as I remove the paper farther from it: so that, if I would believe my sense, I should believe it as very a body upon the paper, as in the candle; though enfeebled, by the laxity of the channel in which it floweth.

And this seemeth to be strengthened, by the consideration of the adversaries position: for if it were a quality; then, seeing it hath no contrary to destroy or stop it, it should still produce an equal to it self, without end or growing feeble, whensoever it meeteth with a subject capable to entertain it, as air is.

The better to apprehend how much this faine resemblance of flame upon the paper, maketh for our purpose; let us turn the leaf, and imagine in our thoughts, after what fashion that fire which is in the flame of a little candle, would appear unto us, if it were dilated and stretched out to the utmost extent that excess of rarity can bring it unto. Suppose that so much of flame, as would fill a cone of two inches height and half an inch diameter should suffer so great an expansion as to replenish with his light body a large chamber: and then, what can we imagine it would seem to be? How would the con-

4.

The two first reasons to prove light to be a body, are, the resemblance it hath with fire: and because if it were a quality, it would alwaies produce an equal to it self.

5.

The third reason; because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.

tinual driving it into a thinner substance, as it streameth in a perpetual floud from the flame, seem to play upon the paper? And then judge whether it be likely to be a body or no, when our discourse suggesteth unto us, that if it be a body, those very appearances must follow, which our eyes give us evidence are so in eff. &c. If gold beaten into so airy a thinness as we see gilders use, doth remain still gold notwithstanding the wonderfull expansion of it: why shall we not allow, that fire dilated to his utmost period, shall still remain fire; though extremely rarified beyond what it was?

6.
The fourth
reason, from
the manner of
the generation
and corrupti-
on of light,
which agreeth
with fire.

We know that fire is the rarest and the subtilest substance that nature hath made among bodies; and we know likewise, that it is ingendred by the destroying and seeding upon some other more gross body: let us then calculate, when the oyl or tallow, or wax of a candle, or the bulk of a faggot or billet, is dilated and rarified to the degree of fire, how vast a place must it take up?

To this let us add what *Aristotle* teacheth us; that fire is not like a standing pool, which continueth full with the same water; and as it hath no waste, so it hath no supply: but it is a fluent and brook-like current. Which also we may learn, out of the perpetual nutriment it requireth: for a new part of fuel, being converted into a new part of fire (as we may observe, in the little attoms of oyl, or melted wax, that continually ascend apace up the week of a burning candle or lamp) of necessity the former must be gone to make room for the latter; and so, a new part of the river is continually flowing.

Now then, this perpetual flux of fire, being made of a gross body that so rarified will take up such a vast rom; if it die not at the instant of its birth, but have some time to subsist (be it never so short,) it must needs run some distance from the fountain whence it springeth. Which if it do, you need not wonder, that there should be so great an extent of fire as is requisite to fill all that space which light replenisheth; nor that it should be still supplied with new, as fast as the cold of the air killeth it: for considering that flame is a much grosser substance than pure fire, (by reason of the mixture with it, of that viscous oily matter, which being drawn out of the wood and candle, serveth for fuel to the fire, and is by little and little converted

converted into it;) and withall reflecting upon the nature and motion of fire, (which is, to dilate it self. extremely, and to fly all about from the center to the circumference;) you cannot choose but conceive, that the pure fire struggling to break away from the oily scum (which is still turning into new fire) doth at length free his wings from that birdlime, and then flieth abroad with extreme swiftness, and swelleth and dilateth it self to a huge bulk, now that it hath gotten liberty; and so filleth a vast room; but remaineth still fire till it die: which it no sooner doth, but it is still supplied with new streames of it that are continually strained, and as it were squeezed out of the thick flame, which did imprison it, and kept it within it, till growing fuller of fire than it could contain (by reason of the continual attenuating the oily parts of it, and converting them into fire) it giveth libertie to those parts of fire, that are next the superficies, to fly whither their nature will carry them.

And thus, discourse would inform a blind man (after he hath well reflected on the nature of fire) how it must needs fill a mighty extent of place; though it have but a narrow beginning at the spring-head of it: and that there, by reason of the condensation of it, and mixture with a grosser body, it must needs burn other bodies; but that when it is freed from such mixture, and suffereth an extreme expansion, it cannot have force to burn, but may have means to express it self to be there present by some operation of it upon some body that is refined and subtilized enough to perceive it. And this operation a seeing man will tell you is done upon his eyes, (whose fitness to receive impression from so subtle an agent, Anatomists will teach you.) And I remember, how a blind school-master that I kept in my house to teach my children (who had extreme subtle spirits, and a great tenderness through his whole body, and met with few distractions, to hinder him from observing any impression, never so nicely made upon him) used often to tell me, that he felt it very perceptibly in several parts of his body; but especially in his brain.

But to settle us more firmly in the persuasion of lights being a body (and consequently fire;) let us consider that the properties or a body, are perpetually incident to light; look what rules a ball will keep in its rebounds, the same doth light in bodies.

its reflexions : and the same demonstration doth alike convince the one and the other. Besides, light is broken like a body ; as when it is snapped in peices by a tougher body. It is gathered together into a little room by looking or burning glasses ; as water is, by ordering the gutters of a house so as to bring into one cistern all that raineth dispersedly upon the whole roof. It is seled and dispered by other glasses ; and is to be wrought upon, and cast hither and thither at pleasure ; all by the rule of other bodies. And what is done in light, the same will likewise be done in heat, in cold, in wind, and in sound. And the very same instruments that are made for light, will work their effects in all these others, if they be duly managed.

So that certainly, were it not for the authority of *Aristotle* and of his learned followers that presseth us on the one side ; and for the seemingness of those reasons we have already mentioned, which perswadeth us on the other side ; our very eyes would carry us by stream into this consent, that light is no other thing but the nature and substance of fire, spread far and wide, and freed from the mixture of all other gross bodies. Which will appear yet more evident in the solutions of the oppositions we have brought against our own opinion : for in them there will occur other arguments of no less importance to prove this verity, than these we have already proposed.

CHAP. VII.

Two objections answered against light being fire ; with a more ample proof of its being such.

1.
That all light
is hot and apt
to heat.

HAVING then said thus much to perswade us of the corporeity of this subtle thing, that so queintly playeth with our eyes : we will in the next place examine those objections that at the beginning we did set down against its being a body : and if after a through discussion of them, we find they do in truth conclude nothing of what at the first sight they bear so great a shew of ; but that we shall be able perfectly to solve and enerve their force ; no body will think it rashness in us to crave leave of *Aristotle* that we may dissent from him in a matter that he hath not looked to the bottom of ; and whose opinion therein can-

cannot be defended from plain contradictions and impossibilities. It is true, never any one man looked so far as he into the bowels of nature; he may be rightly termed the genius of it; and whosoever followeth his principles in the main, cannot be led into error; but we must not believe that he or any man else that relieth upon the strength and negotiation of his own reason, ever had a privilege of infallibility entailed to all he said. Let us then admire him for what he hath delivered us: and where he falleth short or is weary in his search, and suffereth himself to be born down by popular opinions, against his own principles (which happeneth very seldom to him) let us seek to supply and relieve him.

But to pursue our intent: We will begin with answering the third objection; which is, That if light were fire, it must heat as well as enlighten where it shineth. There is no doubt but it doth so: as is evident by the weather-glasses, and other artificial musical instruments (as organs and virginals that playd by themselves) which *Cornelius Drebbel* (that admirable master of mechanicks) made to shew the king. All which depended upon the rarefaction and condensation of some subtile body, conserved in a cavities within the bulk of the whole instrument: for as soon as the sun shined, they would have motion and play their parts. And there is no doubt but that grew out of the rarefaction of the subtile liquor he made use of, which was dilated as soon as the air was warmed by the sun-beams. Of whose operation it was so sensible, that they no sooner left the horizon, but its motion ceased. And if but a cloud came between the instrument and them, the musick would presently go slower for a time. And the ancient miracle of *Memnon's* statue, seemeth to be a juggling of the *Ethiopian* priests made by the like invention.

But though he and they found some spiritual and refined matter: that would receive such notable impressions, from so small alterations of temper; yet it is no wonder that our grosse bodies are not sensible of them: for we cannot feel heat unless it be greater than that which is in our sense. And the heat there must be in proportion to the heat of our blood; which is an high degree of warmth. And therefore it is very possible

2.

The reason why our bodies for the most part do not feel the heat of pure light.

sible that an exceeding rarified fire, may cause a far less impression of heat than we are able to feel. Consider how if you set pure spirit of wine on fire, and so convert it into actual flame; yet it will not burn, nor scarce warm your hand: and then can you expect that the light of a candle which filleth a great room, should burn and warm you so far as it shineth?

If you would exactly know what degree of heat, and power of burning that light hath, which (for example) shineth upon the wall in a great chamber, in the midst whereof there standeth a candle; do but calculate what overproportion of quantity all the light in the whole room beareth to the quantity of the little flame at the top of the candle, and that is the overproportion of the force of burning which is in the candle, to the force of burning which is in so much light at the wall as in extension is equal to the flame of the candle. Which, when you have considered, you will not quarrel at its not warming you at that distance; although you grant it to be fire, streaming out from the flame as from the spring that feedeth it, and extremely dilated (according to the nature of fire, when it is at liberty) by going so far, without any other gross body to imprison or clog it.

It is manifest, that this rule of examining the proportion of burning in so much of the light as the flame is, (by calculating the proportion of the quantity or extension of all the light in the room to the extension of the flame of the candle, and then comparing the flame of the candle to a part of light equal in extension unto it) is a good and infallible one, if we abstract from accidental inequalities: since both the light and the flame are in a perpetual flux; and all the light was first in the flame, which is the spring from whence it continually floweth. As in a river wherein every part runneth with a settled stream; though one place be straighter, and another broader; yet of necessity, since all the water that is in the broad place came out of the narrow, it must follow that in equal portions of time, there is no more water where it hath the liberty of a large channel, than where the banks press it into a narrow bed, so that there be no inequalities in the bottom.

In like manner, if in a large stove a basin of water be converted

verted into steam, that rarified water which then filleth the whole stove, is no more than what the basin contained before: and consequently, the power of moistening which is in a foots extension (for example) of the stove wherein that steam is, must be in proportion to the vertue of wetting in the foots extension of water; as the quantity of that great room which the steam filleth, is to the quantity of the water contained in the bason: for although the rarified water be not in every least part of that great place it seemeth to take up; by reason that there is air in which it must swim; yet the power of wetting that was in the bason of water, is dilated through the whole room, by the conjunction of the mist or dew to all the sensible parts of the air that is in the room: and consequently the power of wetting which is in any foot of that room, is in a manner as much less than the power of wetting which was in the foot of water, as if the water were rarified to the quantity of the whole room, and no air were left with it.

And in the same manner it fareth with dilated fire, as it doth with dilated water, with onely this difference peradventure, that fire groweth purer and more towards its own nature by dilatation; whereas water becometh more mixed, and is carried from its nature by suffering the like effect. Yet dilated water will in proportion moisten more than dilated fire will burn; for the rarefaction of water bringeth it nearer to the nature of air (whose chief propriety is moisture,) and the fire that accompanieth it when it raiseth it into steam, giveth it more powerfull ingression into what body it meeteth withall: whereas fire when it is very pure, and at entire liberty to stretch and spread it self as wide as the nature of it will carry it, getteth no advantage of burning by its mixture with air: and although it gaineth force by its purity, yet by reason of its extreme rarefaction it must needs be extremely faint. But if by the help of glasses you will gather into less room that which is diffused into a great one, and so condense it as much as it is (for example) in the flame of a candle; then that fire or compacted light will burn much more forcibly than so much flame: for there is as much of it in quantity (excepting what is lost in the carriage of it;) and it is held in together in as little room; and it hath this advantage besides,

besides, that it is clogged with no gross body to hinder the activity of it.

3.
The experience of burning-glasses, and of soutry gloomy weather, prove light to be fire.

It seemeth to me now, that the very answering this objection doth (besides repelling the force of it) evidently prove that light is nothing but fire in his own nature, and exceedingly dilated: for if you suppose fire (for example the flume of a candle) to be stretched out to the utmost expansion that you may well imagin such a gross body is capable of; it is impossible it should appeare and worke otherwise than it doth in light, as I have shewed above. And again, we see plainly that light gathered together burneth more forcibly than any other fire whatsoever, and therefore must needs be fire.

Why then shall we not confidently conclude, that what is fire before it getteth abroad, and is fire again when it cometh together, doth likewise remain fire during all its journey? Nay even in the journey it self we have particular testimony that it is fire: for light returning back from the earth charged with little atoms (as it doth in soutry gloomy weather) heateth much more than before; just as fire doth when it is imprisoned in a dense body.

4.
Philosophers ought not to judge of things by the rules of vulgar people.

Philosophers ought not to judge by the same rules that the common people doth. Their gross sense is all their guide: and therefore they cannot apprehend any thing to be fire, that doth not make it self be known for such by burning them. But he that judiciously examineth the matter, and traceth the pedigree and period of it; and seeth the reason why in some circumstances it burneth, and in other parts it doth not; is too blame, if he suffer himself to be led by others ignorance contrary to his own reason. When they that are curious in perfumes, will have their chamber filled with a good scent in a hot season that agreeth not with burning perfumes, and therefore do make some odoriferous water be blown about it by their servants mouths that are dexterous in that ministry, (as is used in *Spain* in the summer time;) every one that seeth it done, though on a sudden the water be lost to his eyes and touch, and is onely discernable by his nose; yet he is well satisfied that the scent which recreateth him, is the very water he saw in the glass extremely dilated by the forcible sprouting of it out from the servants mouth, and will by little and little fall down and become again palpable

pable water as it was before; and therefore doubteth not but it is still water whiles it hangeth in the air divided into little atoms. Whereas one that saw not the beginning of this operation by water, nor observed how in the end it sheweth it self again in water, might the better be excused if he should not think that what he smelled were water blown about the air, nor any substance of it self (because he neither seeth nor handleth it) but some adventitious quality he knoweth not how adhering to the air. The like difference is between Philosophers that proceed orderly in their discourses, and others that pay themselves with terms which they understand not. The one see evidence in what they conclude; whiles the others guess wildly at random.

I hope the Reader will not deem it time lost from our main drift, which we take up thus in examples and digressions: for if I be not much deceived, they serve exceedingly to illustrate the matter: which I hope I have now rendred so plaine, as no man that shall have well weighed it, will expect that fire dilated into that rarified substance which mankind (who according to the different appearance of things to their sense, giveth different names unto them) calleth light, should burn like that grosser substance which from doing so they call fire; nor doubt but that they may be the same thing more or lesse attenuated; as leaf-gold that flieth in the air as light as down, is as truly gold as that in an ingot which being heavier than any other substance, falleth most forcibly unto the ground.

What we have said of the unburning fire (which we call light) streaming from the flame of a candle, may easily be applyed to all other lights deprived of sensible heat; whereof some appear with flame, others without it: of the first sort of which, are the innoxious flames, that are often seen on the hair of mens heads, and horses manes, on the masts of ships, over graves, and fat marsh ground, and the like: and of the latter sort are glow-worms, and the light-conserving stones, rotten wood, some kinds of fish and of flesh when they begin to putrifie, and some other things of the like nature.

Now to answer the second part of this objection, that we daily see great heats without any light, as well as much light with-

5.

The different names of light and fire proceed from different notions of the same substance.

6.

The reason
why many
times fire and
heat are depri-
ved of light.

without any heat, and therefore light and fire cannot be the same thing: you may call to minde how dense bodies are capable of great quantities of rare ones; and thereby it cometh to passe, that bodies which repugn to the dilatation of flame, may nevertheless have much fire enclosed in them. As in a stove, let the fire be never so great, yet it appeareth not outwards to the sight, although that stove warm all the rooms neer it: So when many little parts of heat are imprisoned in as many little cells of gross earthly substance, (which are like so many little stoves to them) that imprisonment will not hinder them from being very hot to the sense of feeling (which is most perceptible of dense things.) But because they are choaked with the closeness of the grosse matter wherein they are enclosed, they cannot break out into a body of flame or light, so to discover their nature: which (as we have said before) is the most unfit way for burning; for we see that light must be condensed to produce flame and fire; as flame must be to burn violently.

Having thus cleared the third objection, (as I conceive;) let us go on to the fourth; which requireth that we satisfie their inquisition, who ask what becometh of that vast body of shining light (if it be a body) that filleth all the distance between heaven and earth; and vanisheth in a moment as soon as a cloud or the Moon interposeth it self between the Sonne and us, or that the Sun quitteth our Hemisphere? No signe at all remaineth of it after the extinction of it, as doth of all other substances, whose destruction is the birth of some new thing. Whither then is it flown? We may be perswaded that a mist is a corporeall substance, because it turneth to drops of water upon the twigs that it environeth: and so we might believe light to be fire, if after the burning of it out, we found any ashes remaining; but experience assureth us, that after it is extinguished, it leaveth not the least *vestigium* behind it of having been there.

7. Now, before we answer this objection; we will entreat our
What becom- adversary to call to minde, how we have in our solution of the
meth of the former declared and proved that the light, which (for example)
body of light shineth from a candle, is no more than the flame is, from
when it dieth. whence it springeth, the one being condensed and the other di-
lated; and that the flame is in a perpetual flux of consumption
about

about the circumference, and of restoration at the center, where it sucketh in the fuel: and then we will enquire of him, what becometh of that body of flame which so continually dieth and is renewed, and leaveth no remainder behind it; as well as he doth of us, what becometh of our body of light, which in like manner is alwaies dying, and alwaies springing fresh? And when he hath well considered it, he will finde that one answer will serve for both.

Which is, That as the fire streameth out from the fountain of it, and groweth more subtle by its dilatation, so sinketh the more easily into those bodies it meeteth withall: the first of which, and that environeth it round about, is air. With air then it mingleth and incorporateth it self; and by consequence with the other little bodies that are mingled with the air: and in them it receiveth the changes which nature worketh: by which it may be turned into the other elements, if there be occasion; or be still conserved in bodies that require heat.

Upon this occasion, I remember a rare experiment that a noble man of much sincerity, and a singular friend of mine, told me he had seen: which was, That by means of glasses made in a very particular manner, and artificially placed one by another, he had seen the sun-beams gathered together, and precipitated down into a brownish or purplish red powder. There could be no fallacy in this operation: for nothing whatsoever was in the glasses when they were placed and disposed for this intent: and it must be in the hot time of the year, else the effect would not follow. And of this Magistracy he could gather some daies neer two ounces in a day. And it was of a strange volatile nature, and would pierce and imprint his spiritual quality into gold it self (the heaviest and most fixed body we converse withall) in a very short time. If this be plainly so, without any mistaking; then mens eyes and hands may tell them what becometh of light when it dieth, if a great deal of it were swept together. But from what cause soever this experience had its effect, our reason may be satisfied with what we have said above; for I confesse, for my part, I believe the appearing body might be something that came along with the sun-beams; and was gathered by them; but not their pure substance.

Some peradventure will object those lamps, which both an-
cient

8.

An experi-
ment of some
who pretend,
that light may
be precipita-
ted into pow-
der.

9.

The Authors
opinion con-
cerning lamps
pretended to
have been
found in tombs
with incon-
sumptible
lights.

tient and modern writers have reported to have been found in tombs and urns, long time before closed up from mens repair unto them to supply them with new fuel: and therefore they believe such fires to feed upon nothing; and consequently, to be inconsumptible and perpetual. Which if they be, then our doctrine that will have light to be nothing but the body of fire perpetually flowing from its center, and perpetually dying; cannot be found: for in time such fires would necessarily spend themselves in light: although light be so subtile a substance that an exceeding little quantity of fewell may be dilated into a vast quantity of light. Yet still there would be some consumption, which how imperceptible soever in a short time, yet after a multitude of revolutions of years, it must needs discover it self.

To this I answer: That for the most part, the witnesses who testifie originally the stories of these lights, are such as a rational man cannot expect from them that exactnesse or nicety of observation. which is requisite for our purpose; for they are usually gross labouring people, who as they dig the ground for other intentions, do stumble upon these lamps by chance before they are aware: and for the most part, they break them in the finding; and they imagine they see a glimpse of light, which vanisheth before they can in a manner take notice of it; and is peradventure but the glistering of the broken glasse or glazed pot, which reflecteth the outward light as soon as by rummaging in the ground and discovering the glasse, the light striketh upon it; (in such manner as sometimes a Diamond by a certain encountering of light in a dusky place, may in the first twickling of the motion, seem to sparkle like fire:) and afterwards when they shew their broken lamp, and tell their tale to some man of a pitch of wit above them, who is curious to inform himself of all the circumstances that may concern such lights; they strain their memory to answer him satisfactorily unto all his demands: and thus for his sake they perswade themselves to remember what they never saw: and he again on his side, is willing to help out the story a little. And so after a while, a very formal and particular relation is made of it. As happeneth in like sort in reporting of all strange and unusuall things; which even those that in their nature

nature abhor from lying are naturally apt to strain a little and fashion up in a handsome mould, and almost to perswade themselves they saw more than they did: so innate it is to every man, to desire the having of some preeminence beyond his neighbour; be it but in pretending to have seen something which they have not.

Therefore, before I engage my self in giving any particular answer to this objection of pretended inconsumptible lights, I would gladly see the effect certainly averred and undoubtedly proved: for, the testimonies which *Fortunius Licetus* produceth (who hath been very diligent in gathering them, and very subtil in discoursing upon them, and is the exactest author that hath written upon this subject) do not seem unto me to make that certainty, which is required for the establishing of a ground in Philosophy. Nevertheless, if there be any certain experience in this particular, I should think that there might be some Art by circulation of sewell, to maintain the same light for a great company of years. But I should not easily be perswaded, that either flame or light could be made without any manner of consuming the body which serveth them for sewell.

CHAP. VIII.

*An answer to three other objections formerly
proposed, against light being
a substance.*

HAVING thus defended our selves from their objections, who would not allow light to be fire; and having satisfied their inquiry, who would know what becometh of it when it dieth, if it be a body: we will now apply our selves to answer their difficulties, who will not let it Pass for a body, because it is in the same place with another body; as, when the sun beams enlighten all the air, and when the severall lights of two distinct candles are both of them every where in the same room. Which is the substance of the second main objection.

This of the jussling of the air, is easily answered thus: that the air being a very divisible body, doth without resistance yeeld as much place as is requisite for light. And that light,

E

though

I.
Light is not really in every part of the room it enlighteneth, nor filleth entirely any sensible part of it, though it seem to us to do so.

though our eyes judge it diffused every where, yet is not truly in every point or atom of air: but to make us see it every where, it sufficeth that it be in every part of the air which is as big as the black or sight of our eye; so that we cannot set our eye in any position where it receiveth not impressions of light. In the same manner as perfumes; which though they be so gross bodies that they may be sensibly waisted by the wind; nevertheless, they do so fill the air, that we can put our nose in no part of the room, where a perfume is burned, but we shall smell it. And the like is of mists; as also of the sprouted water to make a perfume, which we mentioned above.

But because pure discourses, in such small things as these, do but weakly bind such readers as are not accustomed unto them; and that I would (if it be possible) render this Treatise intelligible to every rational man, how ever little versed in scholastick learning (among whom I expect it will have a fairer passage, than among those that are already deeply imbued with other principles:) let us try if we can herein inform ourselves by our sense, and bring our eyes for witness of what we say. He then that is desirous to satisfy himself in this particular, may put himself in a dark room, through which the sun sendeth his beames by a cranie or little hole in the wall; and he will discover a multitude of little atoms flying about in that little stream of light; which his eye cannot discern when he is environed on all sides with a full light. Then let him examine whether or no there be light in the midst of those little bodies: and his own reason will easily tell him, that if those bodies were as perspicuous as the air, they would not reflect upon our eyes the beames by which we see them. And therefore he will boldly conclude, that at the least such parts of them as reflect light unto us, do not admit it, nor let it sink into them. Then let him consider the multitude of them; and the little distance betwixt one another; and how nevertheless they hinder not our sight; but we have it free to discover all objects beyond them, in what position soever we place our eye: and when he thus perceiveth that these opacous bodies, which are every where, do not binder the eye from judging light to have an equal plenary diffusion through the whole place that it irradiateth; he can have no difficulty to allow air, (that is diaphanous;

phanous, and more subtile far than they, and consequently, divisible into lesser atoms, and having lesser pores, giveth less scope unto our eyes to miss light, than they do) to be every where mingled with light, though we see nothing but light, and cannot discern any breach or division of it.

Especially, when he shall add unto this consideration; that the subtile body which thus filleth the air, is the most visible thing in the world; and that, whereby all other things are seen: and that the air which it mingleth it self with, is not at all visible; by reason of the extreme diaphaneity of it, and easie reception of the light into every pore of it without any resistance or reflection: and that such is the nature of light, as it easily drowneth an obscure body, if it be not too big: and not onely such, but even other light bodies; for so we know as well the fixed stars as the planets are concealed from our sight by nearness to the sun; neither the lightness of the one, nor the bigness of the other, prevailing against the darkning of an exuperant light: and we have daily experience of the same in very pure chrystal glasses, and in very clear water; which though we cannot discern by our sight if they be in certain positions; nevertheless by experience we find that they reflect much light: and consequently have great store of opacous parts: and then he cannot choose but conclude; that it is impossible but light should appear as it doth, to be every where, and to be one continued thing; though his discourse withall assure him it is every where mingled with air.

And this very answer I think will draw with it by consequence, the solution of the other part of the same objection; which is of many lights joyning in the same place; and the same is likewise concerning the images of colours every where crossing one another without hinderance. But to raise this contemplation a strain higher; let us consider how light being the most rare of all known bodies, is of its own nature (by reason of the divisibility that followeth rarity) divisible into lesser parts than any other; and particularly than flame; which being mixed with smoke and other complency, falleth very short of light. And this, to the proportion in which it is more rare than the body it is compared unto. Now a great Mathematician having devised how to measure the rarefaction of gun-pow-

2.

The least sensible point of a diaphanous body, hath room sufficient to contain both air and light, together with a multitude of beams issuing from several lights, without penetrating one another.

Willebrord Snell

der into flame, found the diameter 50. times encreased; and so concluded, that the body of the flame was in proportion to the body of the gun-powder it was made of, as 125000. is to one. Wherefore by the immediately proceeding consequence, we find that 125000. parts of flame may be couched in the room of one least part of gun-powder, and peradventure many more, considering how porous a body gun-powder is. Which being admitted, it is evident, although light were as gross as the flame of gun-powder, and gun-powder were as solid as gold: yet there might pass 125000. rayes of light, in the space wherein one least part of gun-powder might be contained; which space would be absolutely invisible unto us, and be contained many times in the bigness of the sight of a mans eye. Out of which we may gather what an infinity of objects may seem unto us to cross themselves in the same indivisible place, and yet may have room sufficient for every one to pass his way, without hindering his fellow. Wherefore, seeing that one single light could not send rayes enough to fill every little space of air that is capable of light, (and the less, the farther it is from the flame) it is obvious enough to conceive, how in the space where the air is, there is capacity for the rayes of many candles.

Which being well summed up, will take away the great admiration how the beams of light, though they be corporeal, can in such great multitudes without hindering one another, enter into bodies and come to our eye: and will shew that it is the narrowness of our capacities, and not the defect of nature, which maketh these difficulties seem so great; for she hath sufficiently provided for all these subtile operations of fire; as also for the entrance of it into glass, and into all other solid bodies that are diaphanous (upon which was grounded the last instance the second objection pressed:) for all such Bodies being constituted by the operation of fire (which is alwayes in motion) there must needs be wayes left for it both to enter in, and to evaporate out. And this is most evident in glass which being wrought by an extreme violent fire and swelling with it, as water and other things do by the mixture of fire; must necessarily have great store of fire in it self whiles it is boyling; as we see by its being red hot. And hence it is, that the workmen
are

are forced to let it cool by degrees in such relentings of fire, as they call their nealing heats, lest it should shiver in pieces by a violent succeeding of air in the room of the fire; for that being of greater parts than the fire, would strain the pores of the glass too suddenly, and break it all in pieces to get ingression: whereas in those nealing heats the air being rarer, lesser parts of it succeed to the fire, and leisurely stretch the pores without hurt. And therefore we need not wonder that light passeth so easily through glass; and much less, that it getteth through other bodies; seeing the experience of Alchymists doth assure us, that it is hard to finde any other body so impenetrable as glass.

But now to come to the answer of the first, and in appearance most powerful, objection against the corporeity of light; which urgeth that his motion is performed in an instant, and therefore cannot belong to what is material and clothed with quantity; We will endeavour to shew how unable the sense is to judge of sundry sorts of motions of Bodies, and how grossely it is mistaken in them. And then, when it shall appear that the motion of light must necessarily be harder to be observed than those others: I conceive, all that is raised against our opinion by so incompetent a judge, will fall flat to the ground.

3.

That light doth not enlighten any room in an instant; and that the great celerity of its motion doth make it imperceptible to our senses.

First then, let me put the Reader in minde, how if ever he marked children when they play with fire-sticks, they move and whirle them round so fast, that the motion will cosen their eyes, and represent an entire circle of fire unto them: and were it somewhat distant, in a dark night, that one played so with a lighted torch, it would appear a constant wheel of fire without any discerning of motion in it. And then, let him consider how slow a motion that is in respect of what it is possible a body may participate of: and he may safely conclude, that it is no wonder though the motion of light be not descried, and that indeed no argument can be made from thence, to prove that light is not a body.

But let us examine this consideration a little farther, and compare it to the motion of the earth or heavens: let the appearing circle of the fire, be some three foot diameter, and the

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time

time of one entire circulation of it, be the sixtieth part of a minute; of which minutes, there are 60 in an hour; so that in a whole day, there will be but 86400. of these parts of time. Now the diameter of the wheel of fire being but of three foot, the whole quantity of space that it moveth in that atom of time will be at the most 10. foot; which is three paces and a foot: of which parts, there are neer eleven millions in the compass of the earth: so that if the earth be moved round in 24. hours, it must go neer 130. times as fast as the boyes stick doth, which by its swift motion deceiveth our eye. But if we allow the Sun, the Moon, and the fixed Stars to move; how extreme swift must their flight be, and how imperceptible would their motion be in such a compass as our sight would reach unto? And this being certain, that whether the earth or they do move, the appearances to us are the same; it is evident, that as now they cannot be perceived to move (as peradventure they do not;) so it would be the very same in shew to us, although they did move. If the Sun were neer us, and galloped at that rate; surely we could not distinguish between the beginning and ending of his race: but there would appear one permanent line of light from East to West, without any motion at all: as the torch seemeth to make, with so much a slower motion, one permanent immovable wheel of fire.

But contrary to this effect, we see that the Sun and Stars by onely being removed farther from our eyes, do cosen our sight so grossly that we cannot discern them to be moved at all. One would imagine that so rapid and swift a motion, should be perceived in some sort or other, (which, whether it be in the earth, or in them, is all one to this purpose.) Either we should see them change their places whiles we look upon them, as arrows and birds do when they fly in the air; or else, they should make a stream of light bigger than themselves, as the torch doth. But none of all this happeneth: let us gaze upon them so long and so attentively that our eyes be dazled with looking, and all that while they seem to stand immovable: and our eyes can give us no account of their journey till it be ended. They discern it not whiles it is in doing: so

so that if we consult with no better counsellour than them, we may wonder to see that body at night setting in the West, which in the morning we beheld rising in the East.

But that which seemeth to be yet more strange, is, that these bodies move crosse us, and neverthelesse are not perceived to have any motion at all. Consider then how much easier it is for a thing that moveth towards us, to be with us before we are aware. A nimble fencer will put in a thrust so quick, that the foil will be in your bosome, when you thought it a yard off; because in the same moment you saw his point so far distant, and could not discern it to move towards you, till you felt the rude salutation it gave you. If then you will compare the body of light with these others that thus deceive us in regard of motion, you must needs agree it is much rashnesse to conclude it hath no motion, because we cannot discern the succession of. Consider that it is the subtillest of all the bodies that God hath made. Examine the paths of it, which for the smalnesse of their thrids, and the extreme divisibility of them, and their pliant application of themselves to whatsoever hath pores, are almost without resistance. Calculate the strange multiplication of it, by a perpetual momentary renovation of its streams. And cast with your self, with what extreme force it springeth out and flyeth abroad. And on the other side, reflect how all these things are directly opposite and contrary in those other great bodies, whose motion neverthelesse appeareth not unto us till it be done and past. And when you have well weighed all this, you must needs grant that they who in this case guide themselves merely by what appeareth unto their eyes, are ill judgers of what they have not well examined.

But peradventure some who cannot all of a sudden be weaned from what their sense hath so long fed them with; may ask yet farther, How it chanceth that we have no effects of this motion? It sheweth not it self in the air, coming to us a far off. It stayeth not a thought, or slackneth his speed in flying so vast a space as is from the Sun to us. In fine, there is no discovery of it.

4.
The reason why the motion of light is not discerned coming towards us; and that there is some real tardity in it.

But if *Galileus* his conception be well grounded, that lightning giveth us an incling of its motion, beginning from a little and encreasing to a greater; or if *Monsieur des Cartes* his opinion that it goeth slower in refraction, be true: we shall not need to study long for an answer. But in *Galileus* his experience, it may be the breaking of the cloud which receiveth that succession of motion which we see: and no slowness that light can acquire by the resistance of the refracting body, can be so great as to make that difference of lines which *Monsieur Des Cartes* most ingeniously (though I much doubt not truly) hath applied to yield the reason of refraction: as will appear in our farther discourse.

Therefore these being uncertain; we will, to shew the unreasonableness of this question, suppose there may be some observable tardity in the motion of light; and then ask of them, how we should arrive to perceive it? What sense should we imploy in this discovery? It is true, we are satisfied that sound taketh up time in coming to our eares: but it is, because our eyes are nimbler than they, and can perceive a good way distant the Carpenters Ax falling upon the timber that he heweth, or the fire flashing out of the Canon, before they hear any news of them: but shut your eyes; or inquire of a blinde man; and then neither you nor he can tell whether those sounds fill your eares at the very instant they were begotten, or have spent some time in their journey to you. Thus then our eyes instruct our eares. But is there any sense quicker than the sight? or means to know speedier than by our eyes? Or can they see light, or any thing else; untill it be with them? We may then assuredly conclude, that its motion is not to be discerned as it cometh upon us; nor it self to be perceived, till its beams are in our eyes.

But if there were any means to discover its motion, surely it must be in some *medium*, through which it must struggle to get, as fire doth through iron; which increasing there by degrees, at last (when it is red hot) sendeth beams of light quite through the plate that at the first refused them passage. And it maketh to this purpose, that the light-conserving stones which are gathered in *Italy*, must be set in the Sun for some while before they retain light: and the light will appear in them
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when they are brought back into the dark, greater or lesser (untill they come to their utmost period) according as they have been longer or a lesser while in the Sun. And our eyes the longer they remain in the light, the more dazled they are if they be suddenly passed into the dark. And a curious experimenter did affirm, that the likeness of an object (but particularly he had often observed it of an iron grate) if it be strongly inlightned will appear to another, in the eye of him that looketh strongly and steadily upon it till he be dazled by it, even after he shall have turned his eyes from it. And the wheel of fire could never be made appear unto our eye by the whirling of the fire-stick we even now spoke of; unless the impression made by the fire from one place, did remain in the eye a while after the fire was gone from the place whence it sent that ray. Whence it is evident, that light, and the pictures of objects, do require time to settle and to unsettle in a subject. If then light maketh a greater impression with time, why should we doubt but the first cometh also in time; were our sense so nimble as to perceive it?

But then it may be objected, that the Sun would never be truly in that place in which unto our eyes it appeareth to be: because that, it being seen by means of the light which issueth from it; if that light required time to move in, the Sun (whose motion is so swift) would be removed from the place where the light left it, before it could be with us to give tidings of him. To this I answer, allowing that peradventure it may be so. Who knoweth the contrary? Or, what inconvenience would follow, if it be admitted? Indeed, how can it be otherwise? In refraction, we are sure it is so: and therefore at no time but when the Sun is perpendicularly over our heads, we can be certain of the contrary although it should send its light to us in an instant. Unless happily the truth of the case should be, that the Sun doth not move about us; but we turn to his light: and then, the objection also loseth its aim.

5.
The planets are not certainly ever in that place where they appear to be.

But the more we press the quickness of light, the more we engage our selves, in the difficulty why light doth not shatter the air in pieces, as likewise all solid bodies whatsoever: for the masters of natural Philosophy do tell us, that a softer thing with

6.
The reason why light being a body, doth not by its motion shatter other bodies into pieces.

with a great velocity, is as powerful in effect when it giveth a blow, as a harder thing going slowly. And accordingly experience teacheth us, that a tallow candle shot in a gun will go through a board, or kill a man. Wherefore light having such an infinite celerity, should also have an irresistible force, to pierce and shatter, not onely the air, but even the hardest bodies that are. Peradventure some may think it reasonable to grant the consequence (in due circumstances) since experience teacheth us, that the congregation of a little light by a glasse, will set very solid bodies on fire, and will melt metals in a very short space; which sheweth a great activity: and the great activity sheweth a great percussive force, burning being effected by a kind of attrition of the thing burned. And the great force which fire sheweth in guns, and in mines, being but a multiplication of the same, doth evidently convince that of its own nature it maketh a strong percussive force, when all due circumstances concur. Whereas it hath but little effect if the due circumstances be wanting; as we may observe in the insensible burning of so rarified a body as pure spirit of wine converted into flame.

But we must examine the matter more particularly, and must seek the cause why a violent effect doth not alwaies appear, wheresoever light striketh; for the which we are to note that three things do concur to make a percussive force great: The bignesse, the density, and the celerity of the body moved. Of which three there is onely one in light; to wit, celerity: for it hath the greatest rarity, and the raies of it are the smallest parcels of all natural bodies. And therefore since onely celerity is considerable in the account of lights percussions, we must examine what celerity is necessary to make the stroke of a ray sensible: first then we see that all the motes of the air, nay, even feathers and straws, do make no sensible percussive force when they fall upon us: therefore we must in light have at the least a celerity that may be to the celerity of the straw falling upon our hand (for example,) as the density of the straw is to the density of light, that the percussive force of light may be in the least degree sensible. But let us take a corn of gun-powder in stead of a straw (between which there cannot be much difference) and then putting that the density of fire is to the density of gun-powder as

1. to 125000; and that the density of the light we have here in the earth, is to the density of that part of fire which is in the Sun's body, as the body of the Sun is to that body which is called *Orbis magnus* (whose semidiameter is the distance between the Sun and the Earth;) which must be in subtriple proportion of the diameter of the Sun to the diameter of the great Orb: it followeth that 125000. being multiplied by the proportion of the great Orb unto the Sun (which *Galileo* telleth us is as 106000000 unto one) will give a scantling of what degree of celerity light must have more than a corn of gun-powder, to recompence the excess of weight which is in a corn of gun-powder, above that which is in a ray of light, as big as a corn of gun-powder. Which will amount to be much greater than the proportion of the semidiameter of *Orbis magnus*, to the semidiameter of the corn of gun powder: for if you reckon five grains of gun powder to a barley-corns breadth, and 12. of them in an inch, and 12. inches in a foot, and 3. feet in a pace, and 1000. paces in a mile, and 3500. miles in the semidiameter of the earth, and 1208. semidiameters of the earth in the semidiameter of the *Orbis magnus*, there will be in it but 91324800000000. grains of gun-powder; whereas the other calculation maketh light to be 132500000000000. times rarer than gun-powder; which is almost ten times a greater proportion than the other. And yet this celerity supplieth but one of the two conditions wanting in light to make its percussions sensible, namely density. Now because the same velocity in a body of a lesser bulk, doth not make so great a percussion as it doth in a bigger body; and that the littleness of the least parts of bodies followeth the proportion of their rarity; this vast proportion of celerity must again be drawn into it self, to supply for the excess in bigness that a corn of gun-powder hath over an atom of light: and the product of this multiplication will be the celerity required to supply for both defects. Which evidently sheweth, it is impossible that a ray of light should make any sensible percussion, though it be a body. Especially considering that sense never taketh notice of what is perpetually done in a moderate degree. And therefore after this minute looking into all circumstances, we need not have difficulty in allowing unto light the greatest celerity imaginable, and a percussion proportionate to such a celerity in so rare a body;
and

and yet not fear any violent effect from its blows: unless it be condensed, and many parts of it be brought together to work as if they were but one.

7.
The reason
why the body
of light is ne-
ver perceived
to be fanned
by the wind.

As concerning the last objection; that if light were a body, it would be fanned by the wind: we must consider what is the cause of a thing appearing to be moved: and then examine what force that cause hath in light. As for the first part; we see that when a body is discerned now in one place, now in another, then it appeareth to be moved. And this we see happeneth also in light; as when the Sun or a candle is carried or moveth, the light thereof in the body of the candle or Sun seemeth to be moved along with it. And the like is in a shining cloud or comet.

But to apply this to our purpose: We must note that the intention of the objection is, that the light which goeth from the fire to an opacous body far distant without interruption of its continuity, should seem to be jogged or put out of its way by the wind that crosseth it. Wherein the first failing is, that the objector conceiveth light to send species unto our eye from the midst of its line: whereas with a little consideration he may perceive, that no light is seen by us but that which is reflected from an opacous body to our eye: so that the light he meaneth in his objection is never seen at all. Secondly, it is manifest, that the light which striketh our eye, doth strike it in a straight line; and seemeth to be at the end of that straight line, wheresoever that is; and so can never appear to be in another place: but the light which we see in another place, we conceive to be another light. Which maketh it again evident, that the light can never appear to shake, though we should suppose that light may be seen from the middle of its line; for no part of wind or air can come in to any sensible place in that middle of the line, with such speed that new light from the source doth not illuminate it sooner than it can be seen by us: wherefore it will appear to us illuminated, as being in that place: and therefore the light can never appear shaken. And lastly, it is easier for the air or wind to destroy the light, than it is remove it out of its place, wherefore it can never so remove it out of its place, as that we should see it in another place. But if it should remove it, it would wrap it up within it self and hide it.

8.

In conclusion; after this long dispute concerning the nature
of

of light: if we consider well what hath been said on both sides (to which much more might be added, but that we have already trespass'd in length, and I conceive enough is said to decide the matter) an equal judge will find the balance of the question to hang upon these terms, that, to prove the nature of light to be material and corporeal, are brought a compny of accidents well known to be the proprieties of quantity or bodies, and as well known to be in light. Even so far as that it is manifest that light in its beginning before it be dispersed is fire; and if again it be gathered together, it sheweth it self again to be fire. And the receptacles of it are the receptacles of a body: being a multitude of pores, as the hardness and coldness of transparent things do give us to understand; of which we shall hereafter have occasion to discourse.

The reasons for and against lights being a body, compared together.

On the contrary side, whatsoever arguments are brought against lights being a body, are onely negatives. As that we see not any motion of light; that we do not discern where the confines are between light and air; that wee see not room for both of them, or for more lights to be together; and the like: which is to oppose negative proofs against affirmative ones; and to build a doctrine upon the defect of our senses; or upon the likeness of bodies which are extremely unlike, expecting the same effects from the most subtle as from the most gross ones. All which together, with the authority of *Aristotle* and his followers, have turned light into darkness, and have made us almost deny the light of our own eyes.

Now then, to take our leave of this important question: let us return to the principles from whence we began, and consider; that seeing fire is the most rare of all the Elements, and very dry: and that out of the former it hath, that it may be cut into very small pieces; and out of the latter, that it conserveth its own figure, and so is apt to divide whatsoever fluid body: and joyning to these two principles, that it multiplieth extremely in its source; It must of necessity follow, that it shooteth out in great multitudes little small parts into the air and into other bodies circumfused with great dilatation in a spherical manner. And likewise that these little parts are easily broken; and new ones still following the former, are still multiplyed in straight lines from the place where they break. Out of which it is evident

9.

A summary repetition of the reasons which prove that light is fire.

dent that of necessity it must in a manner fill all places, and that no sensible place is so little, but that fire will be found in it if the medium be capacious. As also, that its extreme least parts will be very easily swallowed up in the parts of the air, which are humid; and by their enfolding, be as it were quite lost; so as to lose the appearance of fire. Again; that in its reflections, it will follow the nature of grosser bodies, and have glidings like them; which is that, we call refractions. That little streamings from it will cross one another in excessive great numbers, in an unsensible part of space, without hindring one another. That its motion will be quicker than sense can judge of; and therefore will seem to move in an instant, or to stand still as in a stagnation. That if there be any bodies so porous with little and thick pores; as that the pores arrive near unto equalling the substance of the body; then, such a body will be so filled with these little particles of fire, that it will appear as if there were no stop in its passage, but were all filled with fire; and yet, many of these little parts will be reflected. And whatsoever qualities else we find in light, we shall be able to derive them out of these principles, and shew that fire must of necessity do what experience teacheth us that light doth. That is to say in one word, it will shew us that fire is light. But if fire be light, then light must needs be fire. And so we leave this matter

C H A P. IX.

Of Local motion in common.

1.
No local motion can be performed without succession.

THough in the fifth chapter, we made onely earth the pretender in the controversy against fire for superiority in activity; (and in very truth, the greatest force of gravity doth appear in those bodies which are eminently earthy:) nevertheless, both water and air (as appeareth out of the 4. chapter of the elements) do agree with earth in having gravity. And gravity, is the chief virtue to make them efficient. So that upon the matter, this place is common to all the three Elements.

Wherefore, to explicate this virtue, whereby these three we ghty Elements do worke; let us call to mind what we said in the beginning of the last chapter concerning local motion: to wit, that according as the body moved, or the divider did more and more enter into the divided body; so, it did joyn it self to some

some new parts of the medium or divided body, and did in like manner forsake others. Whence it happeneth that in every part of motion, it possesseth a greater part of the medium than it self can fill at once. And because by the limitation and confinedness of every magnitude unto just what it is, and no more; it is impossible that a lesser body should at once equalise a greater: it followeth that this division or motion whereby a body attaineth to fill a place bigger than it self, must be done successively: that is, it must first fill one part of the place it moveth in, then another; and so proceed on, till it have measured it self with every part of the place from the first beginning of the line of motion, to the last period of it where the body resteth.

By which discourse it is evident, that there cannot in nature be a strength so great as to make the least or quickest moveable that is, to pass in an instant, or all together, over the least place that can be imagined: for that would make the moved body (remaining what it is, in regard of its bigness) to equalise and fit a thing bigger than it is. Therefore it is manifest, that motion must consist of such parts as have this nature, that whiles one of them is in being, the others are not yet: and as by degrees every new one cometh to be, all the others that were before, do vanish and cease to be. Which circumstance accompanying motion, we call Succession.

And whatsoever is so done, is said to be done *in time*: which is the common measure of all succession, for the change of situation of the stars, but especially of the sun and moon, is observed more or less by all mankind: and appeareth alike to every man: and (being the most known, constant, and uniform succession that men are used unto) is as it were by nature itself set in their way and offered unto them as fittest to estimate and judge all other particular successions, by comparing them both to it, and among themselves by it. And accordingly we see all men naturally measure all other successions, and express their quantities, by comparing them to the revolutions of the heavens; for dayes, hours, and yeares, are nothing else but they, or some determinate parts of them: unto some of which, all other motions and successions must of necessity be referred, if we will measure them. And thus we see how all the mystery of applying time unto particular motions, is nothing else but the considering

2.

Time is the common measure of all succession.

considering how far the Agent that moveth the sun, causeth it to go on in its journey, whiles the agent that moveth a particular body, causeth it to perform its motion.

3. So that it is evident, that velocity is the effect of the superproportion of the one Agent over a certain medium; in respect of what velocity the proportion which another Agent hath to the same medium is, and that it cannot be infinite. And therefore, velocity is a quality by which one succession is intrinsically distinguished from another: though our explication useth to include time in the notions of velocity and tardity. Velocity then, is the effect (as we said) of more strength in the Agent. And having before expressed, that Velocity is a kind of density; we find that this kind of density is an excellency in succession; as permanent density, is an excellency in the nature of substance; though an imperfection in the nature of quantity (by which we see, that quantity is a kind of base alloy added to substance.) And out of this it is evident, that by how much the quicker the motion is in equal mediums, by so much the agent is the perfecter which causeth it to be so quick. Wherefore, if the Velocity should ascend so much as to admit no proportion between the quickness of the one and the tardity of the other, all other circumstances being even, excepting the difference of the agents; then there must be no proportion between the agents. Nor indeed can there be any proportion between them though there were never so great differences in other circumstances, as long as those differences be within any proportion. And consequently, you see that if one agent be supposed to move in an instant, and another in time; whatsoever other differences be in the bodies moved and in the mediums; nevertheless the agent which causeth motion in an instant will be infinite in respect of the agent which moveth in time. Which is impossible: it being the nature of a body, that greater quantity of the same thing hath greater virtue than a less quantity hath; and therefore, for a body to have infinite virtue, it must have infinite magnitude.

If any shou'd say the contrary, affirming that infinite virtue may be in a finite body; I ask, whether in half that body (were it divided) the virtue would be infinite or no? If he acknowledge that it would not; I infer thence, that neither in the two parts together there can be infinite virtue: for two finites cannot compose

pose and make up one infinite. But if he will have the virtue be infinite in each half, he therein alloweth that there is no more virtue in the whole body than in one half of it: which is against the nature of bodies. Now that a body cannot be infinite in greatness, is proved in the second knot of Master *Whites* first Dialogue of the World. And thus it is evident, that by the virtue of pure bodies there can be no motion in an instant.

On the other side it followeth, that there cannot be so little a force in nature, but that giving it time enough, it will move the greatest weight that can be imagined: for the things we treat of, being all of them quantities; they may by division and multiplication, be brought unto equality. As for example; supposing the weight of a movable, to be a million of pounds; and that the mover is able to move the millioneth part of one of those pounds, in a million of years, the millioneth part of a pace, through a *medium* of a certain rarity. Now, seeing that years may be multiplied so, as to equalize the force of this mover, unto the weight of the movable: it followeth clearly that in so many millions of years, this force may move the whole weight of a million of pounds, through the determined *medium* in a determinate number of millions of years, a million of paces: for such a force is equal to the required effect; and by consequence, if the effect should not follow, there would be a compleat cause put, and no effect result from it.

4.
No force so little, that is not able to move the greatest weight imaginable.

But peradventure it is needfull to illustrate this point yet farther: suppose then a weight never so great to be A, and a force never so little to be B. Now if you conceive that some other force moveth A, you must withal conceive that it moveth A some space, since all motion implieth necessarily that it be through some space: let that space be CD. And because a body cannot be moved in a space in an instant, but requireth some time to have its motion performed in; it followeth, that there must be a determined time, in which the conceived force must move the weight A through the space CD: let that time be EF. Now then, this is evident that it is all one to say that B moveth A, and to say that B moveth A through a space in a time; so that if any part of this be left out, it cannot be understood that B moveth A. therefore to express particularly the effect which B is to do upon A, we must say that B must move A a certain

F

space

space in a certain time. Which being so, we may in the next place consider that this effect of moving A may be diminished 2 waies, either because the space it is to be moved in, is lessened; or the time taken up in its motion, is encreased: for, as it is a greater effect, to move A through the space C D, in a less time than E F, so it is a less effect to move the same A, through the space C D, in a greater time than E F; or through a less space than C D in the time E F. Now then, this being supposed, that it is less effect to move A through C D, in a greater time than E F, it followeth also, that a lesser virtue is able to move it through C D in a greater time than E F, than the virtue which is required to move it, through the same space in the time E F. Which if it be once granted (as it cannot be denied) then multiplying the time, as much as the virtue or force required to move A through C D in the time E F is greater than the force B; in so much time, the force B will be able to move A through C D. Which discourse is evident, if we take it in the common terms: but if it be applied to action, wherein Physical accidents intervene, the artificer must have the judgement to provide for them, according to the nature of his matter.

5.
The chief
principle of
Mechanicks
deduced out
of the former
discourse.

Upon this last discourse doth hang the principle which governeth Mechanicks, to wit, that the force and the distance of weights counterpoysing one another, ought to be reciprocal. That is, that by how much the one weight is heavier than the other, by so much must the distance of the lighter from the fixed point upon which they are moved, be greater than the distance of the greater weight from the same point: for it is plain that the weight which is more distant, must be moved a greater space than the neerer weight in the proportion of the two distances. Wherefore the force moving it must carry it in a velocity of the said proportion to the velocity of the other. And consequently, the Agent, or mover, must be in that proportion more powerful than the contrary mover. And out of this practise of Geometricians in Mechanicks (which is confirmed by experience) it is made evident that if other conditions be equal, the excess of so much gravity will make so much velocity. And so much velocity in proportion, will recompence so much gravity.

6.
No movable
that nothing recedeth from quiet or rest, and attaineth a great degree

degree of celerity, but it must passe through all degrees of celerity that are below the obtained degree. And the like is, in passing from any lesser degree of velocity unto a greater : because it must passe through all the intermediate degrees of velocity. For by the declaration of velocity, which we have even now made, we see that there is as much resistance in the *medium* to be overcome with speed, as there is for it to be overcome in regard of the quantity ; or line of extent of it : because (as we have said) the force of the Agent in counterpoises, ought to be increased as much as the line of extent of the *medium*, which is to overcome by the Agent in equal time, doth exceed the line of extent of the *medium*, along which the resistant body is to be moved. Wherefore, it being proved that no line of extent can be overcome in an instant, it followeth, that no defect of velocity which requireth as great a superproportion in the cause, can be overcome likewise in an instant.

And by the same reason by which we prove that a movable cannot be drawn in an instant from a lower degree of velocity to a higher, it is with no lesse evidence concluded that no degree of velocity can be attained in an instant : for divide that degree of velocity into two halves, and if the Agent had overcome the one half, he could not overcome the other half in an instant : much lesse therefore is he able to overcome the whole (that is, to reduce the movable from quiet to the said degree of velocity) in an instant.

Another reason may be, because the movers themselves (such movers as we treat of here) are bodies likewise moved, and do consist of parts : whereof not every one part, but a competent number of them, doth make the moving body to be a fit Agent able to move the proposed body in a proposed degree of celerity. Now this Agent meeting with resistance in the movable, and not being in the utmost extremity of density, but condensable yet farther, (because it is a body ;) and that every resistance (be it never so small) doth worke something upon the mover (though never so hard) to condense it ; the parts of the mover that are to overcome this resistance in the movable, must (to worke that effect) be condensed and brought together as close as is needfull, by this resistance of the movable to the mover ; and so, the remote

parts of the mover, become neerer to the movable, which cannot be done but successively, because it includeth local motion. And this application being likewise divisible, and not all the parts flocking together in an instant to the place where they are to exercise their power; it followeth, that whiles there are fewer moving parts knit together, they must needs move less and more weakly, than when more or all of them are assembled and applied to that work. So that, the motive virtue encreasing thus in proportion to the multiplying of the parts applied to cause the motion; of necessity, the effect (which is obedience to be moved, and quickness of motion in the movable) must do so too: that is, it must from nothing, or from rest, passe through all the degrees of celerity until it arrive to that which all the parts together are able to cause.

As for example, when with my hand I strike a ball; till my hand toucheth it, it is in quiet; but then it beginneth to move; yet with such resistance, that although it obey in some measure the stroke of my hand, nevertheless it presseth the yielding flesh of my palm backwards towards the upper and bony part of it. That part then overtaking the other, by the continued motion of my hand; and both of them joyning together to force the ball away; the impulse becommeth stronger, than at the first touching of it. And the longer it presseth upon it, the more the parts of my hand do condense and unite themselves to exercise their force; and the ball therefore must yield the more; and consequently the motion of it groweth quicker and quicker, till my hand parteth from it. Which condensation of the parts of my hand encreasing successively by the parts joyning closer to one another, the velocity of the balls motion (which is an effect of it) must also encrease proportionably thereunto. And in like manner the motion of my hand and arm, must grow quicker and quicker and passe all the degrees of velocity between rest and the utmost degree it attaineth unto: for seeing they are the spirits swelling the nerves, that cause the arms motion, (as we shall hereafter shew;) upon its resistance, they flock from other parts of the body to overcome that resistance. And since their journey thither requireth time to perform it in; and that the neereft come first; it must needs follow, that as they grow more and more in number, they must more power-

powerfully overcome the resistance; and consequently, encrease the velocity of the motion, in the same proportion as they flock thither; until it attain that degree of velocity, which is the utmost period that the power, which the Agent hath to overcome the resistance of the medium can bring it self unto. Between which and rest, or any other inferiour degree of velocity, there may be designed infinite intermediate degrees, proportionable to the infinite divisibility of time, and space, in which the mover doth move. Which degrees do arise out of the reciprocal yielding of the medium. And that is likewise divisible in the same infinite proportion.

Since then, the power of all natural Agents is limited; the mover (be it never so powerfull) must be confined to observe these proportions; and cannot pass over all these infinite designable degrees in an instant; but must allot some time (which hath a like infinity of designable parts) to ballance this infinity of degrees of velocity: and so consequently, it requireth time, to attain unto any determinate degree. And therefore cannot recede immediately from rest unto any degree of celerity, but must necessarily pass through all the intermediate ones.

Thus it is evident that all motion which hath a beginning must of necessity increase for some time. And since the works of nature are in proportion to their causes, it followeth that this encrease is in a derminate proportion. Which *Galileus* (unto whom we owe the greatest part of what is known concerning motion) reacheth us how to finde out; and to discover what degree of celerity any moveable that is moved by nature, hath in any determinate part of the space it moveth in.

Having settled these conditions of motion; we shall do well in the next place to enquire after the causes of it: as well in the body moved, as also in the mover that occasioneth the motion. And because we have already shewed, that local motion is nothing in substance but division: we may determine that those causes which contribute to division, or resist it, are the causes which make or resist local motion. It hath also been said, that Density hath in it a power of dividing; and that Rarity is the cause of being divided; likewise we have said that fire by reason of its smal parts, into wch it may be cut (which maketh them sharp) hath also an eminence in dividing: so that we have two qualities, density and tenuity

7.

The conditions which help to motion, in the moveable are three in the medium one.

Dialog 1. of Motion. or sharpness which concur actively to division. We have told you also how *Galileus* hath demonstrated that a greater quantity of the same figure and density, hath a privilege of descending faster than a lesser. And that privilege consisteth in this, that the proportion of the superficies to the body it limiteth (which proportion the greater it is, the more it retardeth) is less in a greater bulk than in a smaller.

We have therefore three conditions concurring to make the motion more efficacious: namely, the density, the sharpness, and the bulk of the moveable. And more than these three, we cannot expect to find in a moved body: for quantity hath but three determinations: one, by density and rarity; of which, density is one of the three conditions: another, by its parts; as by a foot, a span, &c. and in this way we have found that the greater excelleth the lesser: the third and last, is by its figure; and in this we find that subtile or edged quantities do prevail over blunt ones. Seeing therefore, that these three determinations be all that are in quantity; there can be no more conditions in the body moved (which of necessity is a finite quantity) but the three named.

And as for the medium which is to be divided, there is only rarity and density (the one, to help; the other, to hinder,) that require consideration on its side. For neither figure, nor littleness and greatness, do make any variation in it. And as for the Agent, it is not as yet time, before we have looked farther into the nature of motion, to determine his qualities.

8. Now then let us reflect how these three conditions do all agree in this circumstance, that they help nothing to division, unless the body in which they are, be moved and pressed against the body that is to be divided, so that we see no principle to persuade us, that any body can move it self towards any determinate part or place of the universe, of its own intrinsecal inclination. For besides that the learned Authour of the *Dialogues de Mundo* (in his third Dialogue, and the second knot) hath demonstrated that a body cannot move unless it be moved by some extrinsecal agent; we may easily frame unto our selves a conceit, of how absurd it is to think that a body by a quality in it can work upon it self: as if we should say, that rarity (which is but more quantity) could work upon quantity: or that figure (which is but that the body reacheth no farther) could work upon

No body hath any intrinsecal virtue to move it self towards any determinate part of the universe.

upon the body: and in general, that the manner of any thing can work upon that thing whose manner it is. For *Aristotle* and *Saint Thomas*, and their intelligent Commentatours, declaring the notion of *Quality*, tell us, that to be a *Quality* is nothing else but to be the determination or modification of the thing whose quality it is.

Besides, that the natural manner of operation is, to work according to the capacity of the subject: but when a body is in the midst of an uniform medium or space, the subject is equally prepared on all sides to receive the action of that body. Wherefore (though we should allow it a force to move) if it be a natural Agent, and have no understanding, it must work indifferently on all sides, and by consequence, cannot move on any side. For if you say that the Agent in this case (where the medium is uniform) worketh rather upon one side than upon another; it must be because this determination is within the Agent it self, and not out of the circumstant dispositions: which is the manner of working of those substances that work for an end of their own; that is, of understanding creatures, and not of natural bodies.

Now he that would exactly determine what motion a body hath, or is apt to have; determining by supposition the force of the Agent; must calculate the proportions of all these three conditions of the moveable, and the quality of the medium: which is a proceeding too particular for the intention of our discourse. But to speak in common, it will not be amiss to examine in what proportion motion doth increase; since we have concluded that all motion proceedeth from quiet by a continual encrease. *Galileus* (that miracle of our age, and whose wit was able to discover whatsoever he had a mind to imploy it about) hath told us that natural motion encreaseth in the proportion of the odd numbers. Which to express by example, is thus: suppose that in the going of the first yard it hath one degree of velocity, then in the going of the second yard it will have three degrees, and in going of the third it will have five: and so onwards, still adding two to the degrees of the velocity, for every one to the space. Or to express it more plainly; if in the first minute of time it goeth one yard of space, then in the next minute it will go three yards, in the third it will go five, in the fourth seven, and so forth.

F 4

But

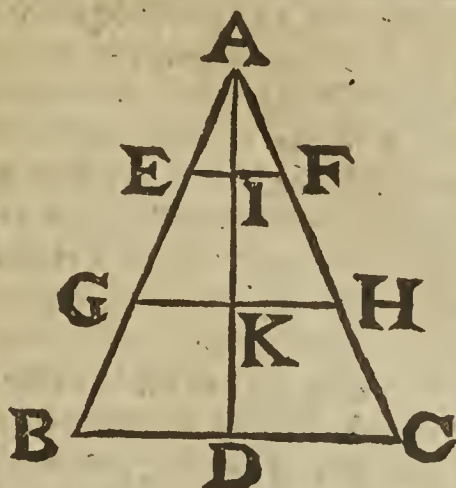
9.

The increase of motion is always made in the proportion of the odd numbers.

But we must enlarge this proposition unto all motions, as we have done the former, of the encrease it self in velocity : because the reason of it is common to all motions. Which is, that all motion (as may appear out of what we have formerly said) proceedeth from two causes; namely, the Agent or the force that moveth, and the disposition of the body moved, as it is composed of the three qualities we lately explicated. In which is to be noted, that the Agent doth not move simply by its own virtue, but it applieth also the virtue of the body moved, which it hath to divide the medium when it is put on. As when we cut with a knife, the effect proceedeth from the knife pressed on by the hand; or from the hand as applying and putting in action the edge and cutting power of the knife. Now this in physicks and Nature is clearly parallel to what in Geometry and Arithmetick the Mathematicians call, drawing one number or one side into another; for as in the Mathematicks, to draw one number into another is to apply the number drawn unto every part of the number into which it is drawn; as if we draw three into seven we make twenty one, by making every unity or part of the number seven to be three: and the like is of lines in Geometry. So in the present case, to every part of the hands motion, we add the whole virtue of the cutting faculty which is in the knife; and to every part of the motion of the knife, we add the whole pressing virtue of the hand. Therefore the encrease of the effect proceeding from two causes so working, must also be parallel to the encrease of the quantities arising out of the like drawing in Mathematicks. But in those, it is evident that the encrease is according to the order of the odd numbers, and therefore it must in our case be the like: that is, the encrease must be in the said proportion of odd numbers. Now that in those the encrease proceedeth so will be evident, if you consider the encrease of an Equicrur triangle; which because it goeth upon a certain proportion of length and breadth, if you compare the encreases of the whole triangle (that gaineth on each side) with the encreases of the perpendicular (which gaineth onely in length) you will see that they still proceed in the foresaid proportion of odd numbers.

Which will be better understood, if we set down the demonstration of it: let the Equicrur triangle be *A B C*: and from the point

point A, draw the line A D perpendicular to the line B C and let it be divided into three equal parts by the lines E F and G H, in the points I and K. And I say, that because the line A K is twice as long as the line A I, therefore the trapezium E F H G, is thrice as big as the triangle A E F: for as A K is to A I, so is G H to E F. But the triangle A G H



is to the triangle A E F, in a double proportion of the line G H to the line E F: which being double the proportion of one triangle to the other must be fourfold: so that subtracting the triangle A E F, the trapezium E F H G remaineth thrice as big as it. And thus the whole triangle getteth an encrease of three, whiles the perpendicular is encreased but one, to make his length two. Which when it cometh to three, the trapezium GHCB that containeth the third division of the perpendicular, becometh five times as big as the triangle AEF; for since the line A D is three times as long as the line A I; and the line B C is three times as long as E F; it followeth that the triangle ABC is nine times as big as the triangle AEF; but AGH is four times as big as AEF; therefore subtracting it from the whole triangle ABC, it leaveth the trapezium GHCB five times as big as the first triangle AEF. Which proposition is very ingeniously set down by the learned Monsieur Gassendi in his first Epistle *de motu impresso a motore translato*, to the same purpose for which we bring it. Though we do not here make use of his scheme and way of demonstration; because we had fallen upon this before his book came abroad: and therefore we onely note his to direct the Reader unto it, who peradventure may like his better than ours. Howbeit we do not conceive that he hath in his discourse there, arrived to the true reason of the effect we search into: as may appear by what we have already delivered.

But we must not imagine, that the velocity of motion will
 alwaies encrease thus for as long as we can fancy any motion: but when it is arrived unto the utmost period that such a move-
 able with such causes is capable of, then it keepeth constantly

10.

No motion can encrease for ever without coming to a the period.

the same pace, and goeth equally and uniformly at the same rate. For since the density or the moveable, and the force of the Agent moving it, (which two do cause the motion) have a limited proportion to the resistance of the medium, how yielding soever it be; it must needs follow, that when the motion is arrived unto that height which ariseth out of this proportion, it cannot exceed it, but must continue at that rate, unless some other cause give yet a greater impulse to the moveable. For velocity consisting in this, that the moveable cutteth through more of the medium in an equal time; it is evident that in the encrease of velocity, the resistance of the medium which is overcome by it, groweth greater and greater, and by little and little gaineth upon the force of the Agent; so that the super-proportion of the Agent, groweth still lesser and lesser as the velocity encreaseth; and therefore at the length they must come to be ballanced. And then the velocity can encrease no more.

And the reason of the encrease of it for a while at the beginning, is because that coming from rest, it must pass through all the intermediate degrees of velocity before it can attain to the height of it, which requireth time to perform, and therefore falleth under the power of our sense to observe. But because we see it do so for some time, we must not therefore conclude, that the nature of such motion is still to encrease without any period or limit; like those lines that perpetually grow nearer, and yet can never meet: for we see that our reason examining the causes of this velocity, assureth us that in continuance of time and space, it may come to sti height which it cannot exceed.

And there would be the pitch at which distance weights being let fall would give the greatest strokes and make greatest impressions. It is true that *Galileus* and *Mersenius* (two exact experimenters) do think they find this verity by their experiences. But surely that is impossible to be done: for the encrease of velocity being in a proportion ever diminishing, it must of necessity come to an insensible encrease in proportion before it endeth: for the space which the moveable goeth through is still encreased; and the time wherein it passeth through that space remaineth still the same little, one as was taken up in passing a less space immediately before; and such little differences of great spaces passed over in a little time, come soon to be undiscernable by sense. But reason (which sheweth us, that if velocity never ceased from

from encreasing, it would in time arrive to exceed any particular velocity; and by consequence, the proportion which the mover hath to the medium, because of the adding still a determinate part to its velocity) concluding plainly that it is impossible, motion should increase for ever, without coming to a period.

Now the impression which falling weights do make, is of two kinds; for the body into which impression is made, either can yeeld backward, or it cannot. If it can yeeld backward, then the impression made is a motion: as we see a stroke with a racket upon a ball, or with a pail-mail beetle upon a bowl maketh it flie from it. But if the stricken body cannot yeeld backward, then it maketh it yeeld on the sides. And this, in divers manners: for if the smitten body be dry and brittle, it is subject to break it, and make the pieces flie round about: but if it be a tough body, it squeeseth it into a larger form.

II.
Certain problems resolved concerning the proportion of some moving Agents compared to their effects.

But because the effect in any of these wayes is eminently greater than the force of the Agent seemeth to be; it is worth our labour to look into the causes of it. To which end we may remember how we have already declared that the force of the velocity is equal to a reciprocal force of weight in the virtue move t: wherefore the effect of a blow that a man giveth with a hammer, dependeth upon the weight of the hammer, upon the velocity of the motion, and upon the hand, in case the hand accompanieth the blow. But if the motion of the hand ceaseth before (as when we throw a thing) then onely the velocity and the weight of the hammer remain to be considered. Howsoever, let us put the hand and weight in one sum which we may equalize by some other virtue or weight. Then let us consider the way or space, which a weight lying upon the thing is to go forwards to do the same effect in the same time as the percussion doth. And what exceeds the line of the blow, hath over the line of that way or space; such an excess we must add of equal weight or force, to the weight we had already taken. And the weight composed of both will be a fit Agent to make the like impression. This problem was proposed unto me by that worthy religious man, Father *Merfenius*: who is not content with advancing learning by his own industry and labours; but besides is always (out of his generous affection to verity) inciting others to contribute to the publick stock of it.

He proposed to me likewise this following question, to wit, why

why there is required a weight of water in double Geometrical proportion, to make a pipe run twice as fast as it did, or to have twice as much water run out in the same time? Unto which I answer out of the same ground as before: That because in running twice as fast, there goeth out double water in every part of time; and again, every part of water goeth a double space in the same part of time; that is to say, because double the celerity is drawn into double the water, and double the water into double the celerity; therefore the present effect is to the former effect, as the effect or quadrate of a double line drawn into it self, is to the effect or quadrate of half the said line drawn into it self. And consequently the cause of the latter effect (which is the weight then) must be to the cause of the former effect (that is, to the former weight) in the same proportion; namely, as the quadrate of a double line, is to the quadrate of half that line. And so you see the reason of what he by experience findeth to be true. Though I doubt not but when he shall set out the Treatise which he hath made of this subject, the Reader will have better satisfaction.

In the mean while, an experience which *Galileo* delivereth will confirm this doctrine. He saith, that to make the same pendant go twice as fast as it did, or to make every undulation of it in half the time it did; you must make the line at which it hangeth, double in Geometrical proportion to the line at which it hanged before. Whence it followeth, that the circle by which it goeth is likewise in double Geometrical proportion. And this being certain, that celerity to celerity hath the proportion of force, which weight hath to weight; it is evident, that as in one case there must be weight in Geometrical proportion; so in the other case, where onely celerity maketh the variance, the celerity must be in double Geometrical proportion, according as *Galileo* findeth it by experience.

But to return to our main intent, there is to be farther noted, that if the subject stricken be of a proportionate celsibility, it seemeth to dull and deaden the stroke: whereas, if the thing stricken be hard, the stroke seemeth to lose no force, but to work a greater effect. Though indeed the truth be, that in both cases the effects are equal; but diverse according to the natures of the things that are stricken; for no force that once is in nature can be lost, but must have its adequate effect one way or other.

Let

Let us then first suppose the body stricken to be a hard body of no exceeding bigness: in which case, if the stroke light perpendicularly upon it, it will carry such a body before it. But if the body be too great, and have its parts so conjoynd, as that they are weaker than the stroke; in this case the stroke driveth one part before it, and so breaketh it from the rest. But lastly if the parts of the stricken body be so easily cessible, as without difficulty the stroke can divide them, then it entereth into such a body until it hath spent its force. So that now making up our account, we see that an equal effect proceedeth from an equal force in all the three cases; though in themselves they be far different. But we are apt to account that effect greater, which is more considerable unto us by the profit or damage it bringeth us. And therefore we usually say, that the blow which shaketh a wall, or beateth it down, and killeth men with the stones it scattereth abroad; hath a greater effect than that which penetrateth far into a mu l wall, and doth little harm: for that innocuousness of the effect, maketh that although in it self it be as great as the other, yet it is little observed or considered.

This discourse draweth on another: which is, to declare how motion ceaseth. And to sum that up in short, we say that when motion cometh unto rest, it decreaseth and passeth through all the degrees of celerity and tardity that are between rest and the height of that motion which so declineth: and that in the proportion of the odd numbers, as we declared above, that it did encrease. The reason is clear: because that which maketh a motion cease, is the resistance it findeth: which resistance is an action of a mover that moveth something against the body which is moved, or something equivalent to such an action: wherefore it must follow the laws that are common to all motions: of which kinde those two are that we have expressed in this conclusion. Now that resistance is a countermotion, or equivalent to one, is plain by this; that any body which is pressed must needs presse again upon the body that presseth it; wherefore the cause that hindereth such a body from yielding, is a force moving that body against the body which presseth it. The particulars of all which we shall more at large declare, where we speak of the action and reaction of particular bodies.

12.

When a movable cometh to rest, the motion doth decrease according to the rules of encrease.

CHAP.

CHAP. X.

Of Gravity and Levity; and of Local Motion, commonly termed Natural.

1. **I**T is now time to consider that distinction of motions which is so famous in *Aristotle*; to wit, that some motions are natural, others violent: and to determine what may be signified by these terms. For seeing we have said that no body hath a natural intrinsecal inclination unto any place, to which it is able to move it self; we must needs conclude that the motion of every body followeth the percussion of extrinsecal Agents. It seemeth therefore impossible that any body should have any motion natural to it self. And if there be none natural, there can be none violent. And so this distinction will vanish to nothing. But on the other side, living creatures do manifestly shew natural motions, having natural instruments to perform certain motions: wherefore such motions must of necessity be natural to them. But these are not the motions which we are to speak of; for *Aristotles* division is common to all bodies, or at the least to all those we converse withall: and particularly to those which are called heavy and light; which two terms passe through all the bodies we have notice of.

Therefore proceeding upon our grounds before layed; to wit, that no body can be moved of it self; we may determine those motions to be natural unto bodies which have constant causes, or percutients to make them alwaies in such bodies: and those violent which are contrary to such natural motions. Which being supposed, we must search out the causes that so constantly make some bodies descend towards the center or middle of the earth; and others to rise and go from the center: by which the world is subject to those restless motions, that keep all things in perpetual flux, in this changing sphere of action and passion.

2. **L**et us then begin with considering what effects the Sunne (which is a constant and perpetuall cause) worketh upon inferiour bodies, by his being regularly sometimes present and sometimes absent. Observe in a pot of water hanging over a fire, how the heat maketh some parts of the water to ascend, and others to supply the room by descending, so that

The first and most general operation of the Sun, is the making and raising of atoms.

that as long as it boyleth, it is in a perpetuall confused motion up and down. Now having formerly concluded that *fire is light, and light is fire*; it cannot be doubted but that the Sunne doth serve in stead of fire to our Glob of Earth and Water, (which may be fitly compared to the boyling pot;) and all the day long draweth vapours from those bodies that his beams strike upon. For he shooting his little darts of fire in multitudes, and in continued streams from his own center against the Python the Earth we live on; they do there overtake one another, and cause some degree of heat as farre as they sink in. But not being able (by reason of their great expansion in their long journey) to convert it into their own nature and set it on fire, (which requireth a high degree of condensation of the beams) they do but pierce and divide it very subtilly, and cut some of the outward parts of it into extreme little atoms. Unto which they sticking very close, and being in a manner incorporated with them (by reason of the moisture that is in them) they do in their rebound back from the earth carry them along with them; like a ball that struck against a moist wall, doth in its return from it, bring back some of the mortar sticking upon it. For the distance of the earth from the Sun is not the utmost period of these nimble bodies flight; so that when by this solid body they are stopped in their course forwards on, they leap back from it, and carry some little parts of it with them: some of them a farther, some of them a shorter journey; according as their littleness and rarity make them fit to ascend. As is manifest by the consent of all Authors that write of the regions of the air; who determine the lower region to reach as far as the reflection of the Sun; and conclude this region to be very hot.

For if we mark how the heat of fire is greatest, when it is incorporated in some dense body; (as in Iron in Sea-Coal) we shall easily conceive that the heat of this region proceedeth mainly out of the incorporation of light with those little bodies which stick to it in its reflection. And experience testifieth the same, both in our fouldry daies, which we see are of a gross temper, and ordinarily go before rain: as also in the hot springs of extreme cold countreys, where the first heats are unsufferable; which proceed out of the resolution of humidity congealed; & in
hot

in hot windes (which the Spaniards call *Bochornos* from *Boca de horn* by allusion to the breathing steam of an Oven when it is opened) which do manifestly shew that the heat of the Sun is incorporated in the little bodies, which compose the steam of that winde. And by the principles we have already layed, the same would be evident; though we had no experience to instruct us; for seeing that the body of fire is dry, the wet parts (which are easiest resolved by fire) must needs stick unto them, and accompany them in their return from the earth.

3. Now whiles these ascend, the air must needs cause others that are of a grosser complexion to descend as fast, to make room for the former, and to fill the places they left, that there may be no vacuity in nature. And to finde what parts they are and from whence they come, that succeed in the room of light and atoms glewed together that thus ascend; we may take a hint from the maxim of the Opticks, that light reflecting maketh equal angles; whence, supposing the superficies of the earth to be circular, it will follow that a perpendicular to the center passeth just in the middle between the two rayes; the incident and the reflected. Wherefore the air between these two rayes, and such bodies as are in it being equally pressed on both sides; those bodies which are just in the middle, are neereft and likeliest to succeed immediately in the room of the light and atomes which ascend from the superficies of the Earth: and their motion to that point is upon the perpendicular. Hence it is evident, that the aire and all such bodies as descend to supply the place of light and atomes, which ascend from the Earth, do descend perpendicularly towards the center of the earth.

And again, such bodies as by the force of light being cut from the Earth or Water, do not ascend in form of light, but do incorporate a hidden light and heat within them; (and thereby are rarer than these descending bodies) must of necessity be lifted up by the descent of those denser bodies that go downwards, because they (by reason of their density) are moved with a greater force. And this lifting up must be in a perpendicular line; because the others descending on all sides perpendicularly, must needs raise those that are between them equally

equally from all sides: that is, perpendicularly from the center of the earth. And thus we see a motion set on foot, of some bodies continually descending, and others continually ascending: all in perpendicular lines, excepting those which follow the course of lights reflexion.

Again as soon as the declining Sun groweth weaker or leaveth our Horizon, and that his beams vanishing do leave the little horsemen which rode upon them, to their own temper and nature (from whence they forced them) they finding themselves surrounded by a smart descending stream, do tumble down again in the night, as fast as in the day they were carried up; and crowding into their former habitations, they exclude those that they finde had usurped them in their absence: And thus, all bodies within reach of the Suns power, but especially our air, are in perpetual motion; the more rarified ones ascending, and the dense ones descending.

Now then, because no bodies wheresoever they be (as we have already shewed) have any inclination to move towards a particular place, otherwise than as they are directed and impelled by extrinsecal Agents: let us suppose that a body were placed at liberty in the open air. And then casting whether it would be moved from the place we suppose it in, and which way it would be moved; we shall finde that it must of necessity happen that it shall descend and fall down till it meet with some other grosse body to stay and support it. For although of it self it would move no way: yet if we finde that any other body striketh efficaciously enough upon it, we cannot doubt but that it will move that way which the striking body impelleth it. Now, it is stricken upon on both sides (above and below) by the ascending, and the descending atoms, the rare ones, striking upon the bottom of it, and driving it upwards, and the denser ones, pressing upon the top of it and bearing it downwards. But if you compare the impressions that the denser atoms make, with those that proceed from the rare ones; it is evident that the dense ones must be the more powerfull; and therefore will assuredly determine the motion of the body in the air, that way they go, which is downwards.

Nor need we fear, lest the littleness of the agents, or the feebleness of their strokes, should not be sufficient to work this

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effect;

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A dense body placed in the air between the ascending and descending stream, must needs descend.

effect; since there is no resistance in the body it self, and the air is continually cut in pieces, by the Sun-beams, and by the motions of little bodies; so that the adhesion unto air of the body to be moved, will be no hinderance to this motion: especially, considering the perpetual new percussions, and the multitude of them, and how no force is so little, but that with time and multiplication it will overcome any resistance.

5. But if any man desireth to look upon, as it were at one view; the whole chain of this doctrine of gravity: let him turn the first cast of his eyes upon what we have said of fire when we explicated the nature of it. To wit, that it beginneth from a little source; and by extreme multiplication and rarefaction, it extendeth it self into a great sphere. And then he will perceive the reason why light is darted from the body of the Sun with that incredible celerity, wherewith its beams fly to visit the remotest parts of the world; and how of necessity, it giveth motion to all circumstant bodies; since it is violently thrust forward by so extreme a rarefaction; and the farther it goeth, is still the more rarified and dilated.

Next, let him reflect how infinitely the quicknesse of lights motion, doth prevent the motion of a moist body, such an one as air is: and then he will plainly see, that the first motion which light is able to give unto the air, must needs be a swelling of that moist element, perpendicularly round about the earth; for, the ray-descendent, and the ray-reflectent, flying with so great a speed, that the air between them cannot take a formal ply any way before the beams of light be on both sides of it: it followeth, that according to the nature of humid things, it must first onely swell: for that is the beginning of motion in them, when heat entereth into them, and worketh upon them. And thus he may confidently resolve himself, that the first motion which light causeth in the air, will be a swelling of it between the two rays towards the middle of them; That is, perpendicularly from the surface of the earth.

And out of this, he will likewise plainly see, that if there be any other little dense bodies floating in the air, they must likewise mount a little, through this swelling and rising of the air. But that mounting will be no more than the immediate parts of the air themselves do move. Because this motion is not by way of

of impulse or stroke that the air giveth those denser bodies; but by way of containing them in it, and carrying them with it, so that it giveth them no more celerity, than to make them go with it self, and as parts of it self.

Then, let him consider, that light or fire, by much beating upon the earth, divideth some little parts of it from others: whereof if any do become so small and tractable, as not to exceed the strength which the rayes have to manage them; the returning rayes, will at their going back, carry away with them or drive before them, such little atoms as they have made or meet with: and so fill the air with little bodies cut out of the earth.

After this, let him consider, that when light carrieth up an atom with it, the light and the atom do stick together, and do make one ascending body; in such sort as when an empty dish lyeth upon the water, the air in the dish maketh one descendent body together with the dish it self: so that the density of the whole body of air and dish (which in this case, are but as one body) is to be esteemed according to the density of the two parts; one of them being allayed by the other, as if the whole were throughout of such a proportion of density, as would arise out of the composition and kneading together the several densities of those two parts. Now then, when these little compounded bodies of light and earth, are carried up to a determinate height; the parts of fire or light, do by little and little break away from them: and thereby, the bulk of the part which is left, becometh of a different degree of density (quantity for quantity) from the bulk of the entire atom, when light was part of it: and consequently it is denser than it was.

Besides, let him consider that when these bodies ascend; they do go from a narrow room to a large one, that is, from the centrewards to the circumference: but when they come down again, they go from a larger part to a narrower. Whence it followeth, that as they descend, they draw closer and closer together, and by consequence, are subject to meet and to fall in one with another; and thereby to increase their bulk, and to become more powerfull in density; not onely, by the losse of their fire; but also by the encrease of their quantity. And so it is evident, that they are denser coming down, than going up.

Lastly, let him consider, that those atoms which went up first,

and are parted from their volatile companions of fire or light, must begin to come down apace, when other new atoms (which still have their light incorporated with them) do ascend to where they are, and do go beyond them by reason of their greater levity. And as the latter atoms come up with a violence and a great celerity, so must the first go down with a smart impulse: and by consequence, being more dense than the air in which they are carried, must of necessity cut their way through that liquid and rare medium; and go the next way to supply the defect and room of the atoms which ascend; (that is, perpendicularly to the earth) and give the like motion to any body they finde in their way, if it be susceptible of such a motion: which it is evident that all bodies are, unless they be stricken by some contrary impulse. For since that a bodies being in a *place*, is nothing else but the continuity of its outside to the inside of the body that containeth it and is its place, it can have no other repugnance to local motion (which is nothing else but a successive changing of place) besides this continuity. Now the nature of density, being the power of dividing; and every least power having some force and efficacy, (as we have shewed above) it followeth that the stroke of every atom (either descending, or ascending) will work something upon any body (though never so big) it chanceth to incounter with, and strike upon in its way, unless there be as strong an impulse the contrary way, to oppose it. But it being determined, that the descending atoms are denser than those that ascend; it followeth that the descending ones will prevail. And consequently, all dense bodies must necessarily tend downwards, to the center (which is, to be *Heavy*) if some other more dense body do not hinder them.

6. Out of this discourse, we may conclude that there is no such thing among bodies, as positive gravity or levity: but that their course upwards or downwards happeneth unto them by the order of nature, which by outward causes giveth them an impulse one of these waies: without which, they would rest quietly wheresoever they are, as being of themselves indifferent to any motion. But because our words express our notions, and they are framed according to what appeareth unto us; when we observe any body to descend constantly towards our earth, we call it heavy; and if it move contrariwise, we call it light. But

Gravity and levity do not signifie an intrinsecal inclination to such a motion in the bodies themselves which are termed heavy and light.

But we must take heed of considering such gravity and levity as if they were Entities that work such effects: since upon examination, it appeareth that these words are but short expressions of the effects themselves: the causes whereof, the vulgar of mankind (who impose names to things) do not consider; but leave that work unto Philosophers to examine; whiles they onely observe, what they see done; and agree upon words to express that. Which words neither will in all circumstances alwaies agree to the same thing; for as cork doth descend in air and ascend in water; so also will any body descend if it lighteth among others more rare than it self, and will ascend if it lighteth among bodies that are more dense than it. And we term bodies light and heavy, onely according to the course, which we usually see them take.

Now proceeding farther on, and considering how there are various degrees of density or gravity, it were irrational to conceive, that all bodies should descend at the same rate, and keep equal pace with one another, in their journey downwards. For as two knives whereof one hath a keener edge than the other, being pressed with equal strength into like yielding matter, the sharper will cut deeper than the other: so, if of two bodies one be more dense than the other, that which is so, will cut the air more powerfully, and will descend faster than the other: for in this case density may be compared to the knives edge, since in it consisteth the power of dividing; as we have heretofore determined. And therefore, the pressing them downwards by the descending atoms, being equal in both (or peradventure greater in the more dense body, as anon we shall have occasion to touch) and there being no other cause to determine them that way; the effect of division must be the greater, where the divider is the more powerfull. Which, the more dense body is; and therefore cutteth more strongly through the resistance of the air; and consequently, passeth more swiftly that way it is determined to move.

I do not mean, that the velocities of their descent shall be in the same proportion to one another, as their densities are: for besides their density, those other considerations which we have discoursed of above when we examined the causes of velocity in motion, must likewise be ballanced. And out of the

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The more dense a body is, the more swiftly it descendeth.

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The velocity of bodies descending, doth not increase in proportion to the difference that may be between their several densities.

comparison of all them ; not out of the consideration of any one alone, resulteth the differences of their velocities : (and that neither, but in as much as concerneth the consideration of the movables : for to make the calculation exact, the *medium* must likewise be considered ; as by and by we shall declare) for since the motion dependeth of all them together ; although there should be difference between the movables in regard of one only, and that the rest were equal ; yet the proportion of the difference of their motions, must not follow the proportion of their difference in that one regard : because their difference considered single in that regard will have one proportion ; and with the addition of the other considerations (though alike in both) to their difference in this, they will have another.

As for example, reckon the density of one movable to be double the density of another movable ; so that in that regard it hath two degrees of power to descend, whereas the other hath but one : suppose then the other causes of their descent to be alike in both, and reckon them all three : and then joyn these three to the one which is caused by the density in one of the movables, as likewise to the two, which is caused by the density in the other movable, and you will finde that thus altogether, their difference of power to descend is no longer in a double proportion (as it would be, if nothing but their density were considered) but is in the proportion of five to four.

But after we have considered all that concerneth the movables, we are then to cast an eye upon the *medium* they are to move in ; and we shall finde the addition of that, to decrease the proportion of their difference, exceedingly more ; according to the celsibility of the *medium*. Which if it be air, the great disproportion of its weight, to the weight of those bodies which men use to take in making experiences of their descent in that yielding *medium*, will cause their difference of velocity in descending, to be hardly perceptible. Even as the difference of a sharp or dull knife, which is easily perceived in cutting of fish or bread, is not to be distinguished in dividing of water or oyl. And likewise in weights, a pound and a scruple will bear down a dramme in no sensible proportion of velocity more than a pound alone would do : and yet put a pound in that scale in stead of the dramme, and then the

the difference of the scruple will be very notable. So then, those bodies, whose difference of descending in water is very sensible (because of the greater proportion of weight in water, to the bodies that descend in it) will yield no sensible difference of velocity when they descend the air, by reason of the great disproportion of weight between air and the bodies that descend in it.

The reason of this will clearly shew it self in abstracted proportions. Thus, suppose air to have one degree of density, and water to have 400; then let the movable A have 410 degrees of density; and the movable B have 500. Now compare their motion to one another in the several *mediums* of air and water. The exuperance of the density of A to water is 10 degrees, but the exuperance of B unto the same water, is 100 degrees; so that B must move in water swifter than A, in the proportion of 100 to ten; that is, of 10 to one. Then let us compare the exuperance of the two movables over air. A is 409 times more dense than air; but B is 499 times more dense than it. By which account, the motion of B, must be in that *medium* swifter than the motion of A, in the proportion of 499 to 409 times: that is, about 50, to 41: which (to avoid fractions) we may account as 10 to 8. But in water they exceed one another as 10 to one: so that their difference of velocity must be scarce perceptible in air in respect of what it is in water.

Out of all which discourse, I only infer in common, that a greater velocity in motion, will follow the greater density of the movable; without determining here their proportions: which I leave unto them, who make that examination their task: for thus much serveth my present turn: wherein I take a survey of nature, but in gross. And my chief drift in this particular is only to open the way for the discovering how bodies that of themselves have no propension unto any determinate place; do nevertheless move constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecal quality that worketh upon them; but by the œconomy of nature, that hath set on foot due and plain causes to produce known effects.

Here we must crave patience of the great soul of *Galileus* (whose admirable learning all posterity must reverence) whiles we reprehend in him; that which we cannot term less than

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absurd:

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More or less
gravity doth
produce a
swifter or a
slower de-

scending of
a heavy body.
Aristotles ar-
gument to dis-
prove motion
in *vacuo*, is
made good.

absurd: and yet, he not onely maintaineth it in several places, but also professeth, *Dial. P^o. de motu*, pag. 81. to make it more clear than day. His position is, that more or less gravity contributeth nothing at all to the faster or slower descending of a natural body: but that all the effect it giveth unto a body, is to make it descend or not descend in such a *medium*. Which is against the first and most known principle that is in bodies: to wit, that more doth more, and less doth less; for he alloweth, that gravity causeth a body to descend; and yet will not allow, that more gravity causeth it to descend more.

I wonder that he never marked how in a pair of scales, a superproportion of overweight in one ballance, lifted up the other faster than a less proportion of overweight would do. Or that more weight hanged to a jack, made the spit turn faster; or to the lines of a clock, made it go faster, and the like.

But his argument whereby he endeavoreth to prove his position, is yet more wonderful: for finding in pendants unequal in gravity, that the lighter went in the same time almost as fast as the heavier; he gathereth from thence, that the different weights have each of them the same celerity: and that it is the opposition of the air, which maketh the lighter body not reach so far at each undulation, as the heavier doth. For reply whereunto; first, we must ask him whether experience or reason taught him, that the slower going of the lighter pendant, proceeded onely from the *medium*, and not from want of gravity? And when he shall have answered (as he needs must) that experience doth not shew this; then we must importune him for a good reason: but I do not finde that he bringeth any at all.

Again, if he admitteth (which he doth in express terms) that a lighter body cannot resist the *medium* so much as a heavier body can, we must ask him, whether it be not the weight that maketh the heavier body resist more: which when he hath acknowledged that it is; he hath therein likewise acknowledged, that whensoever this happeneth in the descending of a body, the more weight must make the heavier body descend faster.

But we cannot passe this matter without noting how himself maketh good those arguments of *Aristotle*, which he seemeth by no means to esteem of: for since the gravity doth overcome the resistance of the *medium* in some proportion; it followeth, that the

the proportions between the gravity and the *medium*, may be multiplied without end; so as, if he suppose that the gravity of a body do make it go at a certain rate in imaginary space, (which is his manner of putting the force of gravity,) then there may be given such a proportion of a heavy body to the *medium*, as it shall go in such a *medium* at the same rate; and nevertheless, there will be an infinite difference, betwixt the resistance of the *medium* compared to that body, and the resistance of the imaginary space compared to that other body which he supposeth to be moved in at the same rate: which no man will stick at confessing to be very absurd.

Then turning the scales, because the resistance of the *medium* doth somewhat hinder gravity, and that with less resistance the heavy body moveth faster; it must follow, that since there is no proportion, betwixt the *medium* and imaginary space; there must neither be any proportion betwixt the time in which a heavy body shall passe through a certain quantity of the *medium*, and the time in which it shall passe through as much imaginary space: wherefore, it must passe over so much imaginary space in an instant. Which is the argument that *Aristotle* is so much laughed at for pressing. And in a word nothing is more evident, than that for this effect which *Galileo* attributeth to gravity, it is unreasonable to put a divisible quality, since the effect is indivisible. And therefore as evident it is that in his doctrine such equality, as intrinsecal gravity is conceived to be, ought not to be put: since every power should be fitted to the effect, or end for which it is put.

Another argument of *Galileo* is as bad as this; when he endeavoureth to prove that all bodies go of a like velocity, because it happeneth that a lighter body in some case, goeth faster than a heavier body in another case: as for example, in two pendants, whereof the lighter is in the beginning of its motion, and the heavier towards the end of it; or if the lighter hangeth at a longer string, and the heavier at a shorter; we see that the lighter will go faster than the heavier. But this concludeth no more, than if a man should prove that a lighter goeth faster than a heavier, because a greater force can make it go faster; for it is manifest, that in a violent motion, the force which moveth a body in the end of its course, is weaker than that which moveth it in the beginning: and the like is, of the two strings. But

10. But here it is not amisse to solve a Problem he putteth which
 The reason belongeth to our present subject. He findeth by experience, that
 why at the inferior quarter if two bodies descend at the same time from the same point, and
 of a circle, a do go to the same point, the one by the inferior quarter of the
 body doth descend faster by which are chords to parts of that arch: he findeth (I say) that the
 the arch of movable goeth faster by the arch, than by any of the chords. And
 that quarter, the reason is evident, if we consider that the neerer any motion
 than by the doth come unto a perpendicular one downwards, the greater velocity
 chord of it. it must have: and that in the arch of such a quadrant, every
 particular part of it inclineth to the perpendicular of the place
 where it is, more than the part of the chord answerable unto it
 doth.

CHAP. XI.

An answer to objections against the causes of natural motions, avowed in the former Chapter; and a refutation of the contrary opinion.

I. **B**UT to return to the third of our doctrine; there may peradventure be objected against it, that if the violence of a bodies
 The first objection answered; why a hollow body descendeth slower than a solid one.
 descent towards the center, did proceed onely from the density of it (which giveth it an aptitude, the better to cut the *medium*) and from the multitude of little atoms descending that strike upon it, and press it the way they go; which is downwards: then it would not import whether the inner part of that body were as solid as the outward parts; for it cutteth with onely the outward, and is smitten onely upon the outward. And yet experience sheweth us the contrary: for a great bullet of lead, that is solid and lead throughout, descendeth faster than if three quarters of the diameter were hollow within; and such a one falling upon any resisting substance, worketh a greater effect than a hollow one. And a ball of brass that hath but a thin outside of metal will swim upon the water, when a massie one sinketh presently. Whereby it appeareth, that it is rather some other quality belonging to the very bulk of the metal in itself; and not these outward causes that occasion gravity.

But this difficulty is easily overcome, if you consider how subtle those atoms are which descending downwards and striking

ing upon a body in their way, do cause its motion likewise downwards: for you may remember how we have shewed them to be the subtilest and the minuteſt divisions that *light*, the subtileſt and ſharpeſt divider in nature, can make. It is then eaſie to conceive that theſe extreme ſubtile bodies do penetrate all others, as *light* doth glaſſ; and do through run them, as ſand doth through a ſmall ſieve, or as water through a ſponge; ſo that they ſtrike, not onely upon the ſuperficies, but as well in every moſt interior part of the whole body; running quite through it all, by the pores of it. And then, it muſt needs follow that the ſolider it is, and the more parts it hath within (as well as without) to be ſtrucken upon, the faſter it muſt go, and the greater effect it muſt work in what it falleth upon: whereas if three quarters of the diameter of it within, ſhould be filled with nothing but with air, the atoms would fly without any conſiderable effect through all that ſpace, by reaſon of the rarity and ceſſibility of it.

And that theſe atoms are thus ſubtile; is manifeſt by ſeveral effects which we ſee in nature. Divers Authors that write of *Egypt* do aſſure us, that though their houſes be built of ſtrong ſtone; nevertheless, a clod of earth laid in the inmoſt room, and ſhut up from all appearing communication with air, will encreaſe its weight ſo notably, as thereby they can judge the change of weather, which will ſhortly enſue. Which can proceed from no other cauſe, but from a multitude of little atoms of ſaltpeter, which floating in the air, do penetrate through the ſtrongeſt walls, and all the maſſie defences in their way, and do ſettle in the clod of earth as ſoon as they meet with it; becauſe it is of a temper ſit to entertain, and to conſerve, and to embody them. Delights have ſhewed us the way, how to make the ſpirits or atoms of ſnow and ſaltpeter paſſe through a glaſſ veſſel; which Alchimiſts hold to be the moſt impenetrable of all they can finde to work with. In our own bodies; the aches which feeble parts do feel before change of weather, and the heavineſſ of our heads and ſhoulders, if we remain in the open air preſently after Sun-ſet; do abundantly teſtifie, that even the groſſer of theſe atoms (which are the firſt that fall) do vehemently penetrate our bodies: ſo as, ſenſe will make us believe, what reaſon peradventure could not.

But beſides all this, there is yet a more convincing reaſon, why
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the descending atoms should move the whole density of a body, even though it were so dense that they could not penetrate it, and get into the bowels of it, but must be content to strike barely upon the outside of it. For nature hath so ordered the matter, that when dense parts stick close together, and make the length composed of them to be very stiff; one cannot be moved but that all the rest (which are in that line) must likewise be thereby moved: so that if all the world were composed of atoms close sticking together, the least motion imaginable must drive on all that were in a straight line, to the very end of the world. This you see is evident in reason, and experience confirmeth it, when by a little knock given at the end of a long beam, the shaking (which maketh sound) reacheth sensibly to the other end. The blinde man that governeth his steps by feeling in defect of eyes, receiveth advertisements of remote things through a staff which he holdeth in his hands, peradventure more particularly than his eyes could have directed him. And the like is of a deaf man that heareth the sound of an instrument, by holding one end of a stick in his mouth, whiles the other end resteth upon the instrument. And some are of opinion (and they not of the rank of vulgar Philosophers) that if a staff were as long as to reach from the Sun to us, it would have the same effect in a moment of time. Although for my part I am hard to believe that we could receive an advertisement so far, unless the staff were of such a thickness as being proportionable to the length might keep it from facile bending: for if it should be very pliant it would do us no service: as we experience in a thrid, which reaching from our hand to the ground, if it knock against any thing, maketh no sensible impression in our hand.

So that in fine, reason, sense, and authority do all of them shew us, that the less the atoms should penetrate into a moving body, by reason of the extreme density of it, the more efficaciously they would work, and the greater celerity they would cause in its motion. And hence we may give the fullest solution to the objection above, which was to this effect: that seeing division is made onely by the superficies or exterior part of the dense body; and that the virtue whereby a dense body doth work, is onely its resistance to division; which maketh it apt to divide: it would follow, that a hollow bowl of brass or iron should be as hea-

heavy as a solid one. For we may answer, that seeing the atoms must strike through the body; and that a cessible body doth not receive their strokes so firmly as a stiff one; nor can convey them so far: if unto a stiff superficies there succeed a yielding inside, the strokes must of necessity lose much of their force; and consequently, cannot move a body full of air with so much celerity, or with so much efficacy as they may a solid one.

But then you may peradventure say, that if these strokes of the descending atoms upon a dense body, were the cause of its motion downwards, we must allow the atoms to move faster than the dense body; that so they may still overtake it and drive it along, and enter into it: whereas if they should move slower than it, none of them could come in their turn to give it a stroke, but it would be past them, and out of their reach before they could strike it. But it is evident (say you) out of these pretended causes of this motion, that such atoms cannot move so swiftly downwards, as a great dense body; since their littleness and their rarity, are both of them hindering to their motion: and therefore this cannot be the cause of that effect which we call gravity.

2.

The second objection answered, and the reasons shown why atoms do continually overtake the descending dense body.

To this I reply; That to have the atoms give these blows to a descending dense body, doth not require that their natural and ordinary motion should be swifter than the descent of such a dense body: but the very descent of it occasioneth their striking it; for as it falleth and maketh it self a way through them, they divide themselves before it, and swell on the sides, and a little above it, and presently close again behinde it and over it as soon as it is past. Now that closing to hinder vacuity of space is a sudden one, and thereby attaineth great velocity; which would carry the atoms in that degree of velocity farther than the descending body, if they did not encounter with it in their way to retard them: which encounter and retarding implyeth such strokes upon the dense body as we suppose to cause this motion. And the like we see in water, into which letting a stone fall, presently the water that was divided by the stone, and swelleth on the sides higher than it was before, closeth upon the back of the descending stone, and followeth it so violently, that for a while after it leaveth a purling hole in the place where the stone went down, till by the repose of the stone, the water returneth likewise to its quiet; and so its superficies becometh even.

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3. In the third place, an enquiry occurreth emergent out of this doctrine, of the cause of bodies moving upwards and downwards. Which is, Whether there would be any natural motion deep in the earth, beyond the activity of the Suns beams? for out of these principles it followeth that there would not: and consequently there must be a vast orb in which there would be no motion of gravity or of levity: for suppose that the Sun beams might pierce a thousand miles deep into the body of the Earth; yet there would still remain a masse, whose diameter would be near 5000 miles, in which there would be no gravitation nor the contrary motion.

A curious question left undecided.

For my part, I shall make no difficulty to grant the inference, as far as concerneth motion caused by our Sun: for what inconvenience would follow out of it? But I will not offer at determining whether there may not be enclosed within that great sphere of Earth, some other fire, (such as the Chymists talk of) an Archeus, a Demogorgon seated in the center, like the heart in animals, which may raise up vapours and boyl an air out of them, and divide gross bodies into atoms; and accordingly give them motions answerable to ours, but in different lines from ours, according as that fire or Sun is situated; since the far-searching Author of the Dialogues *de Mundo*, hath left that speculation undecided, after he had touched upon it in the twelfth knot of his first Dialogue.

4. Fourthly, it may be objected, that if such descending atoms as we have described were the cause of a bodies gravity, and descending towards the center; the same body would at divers times descend more and lesse swiftly; for example, after midnight when the atoms begin to descend more slowly; then likewise the same body would descend more slowly in a like proportion, and not weigh so much as it did in the heat of the day. The same may be said of Summer and Winter: for in Winter time the atoms seem to be more gross; and consequently to strike more strongly upon the bodies they meet with in their way as they descend: yet on the other side, they seem in the Summer to be more numerous, as also to descend from a greater height; both which circumstances will be cause of a stronger stroke and more vigorous impulse upon the body they hit. And the like may be objected of divers parts

The fourth objection answered; Why the descent of the same heavy bodies is equal in so great inequality of the atoms which cause it.

parts of the world, for in the Torrid Zone it will alwaies happen as in Summer in places of the temperate Zone; and in the Polar climes as in deepest Winter: so that no where there would be any standard or certainty in the weight of bodies, if it depended upon so mutable a cause. And it maketh to the same effect, that a body which lieth under a thick Rock, or any other very dense body, that cannot be penetrated by any great store of atoms; should not be so heavy as it would be in the open and free air, where the atoms in their compleat numbers have their full strokes.

For answer to these and such like instances; we are to note first, that it is not so much the number or the violence of the percussion of the striking atoms, as the density of the thing stricken, which giveth the measure to the descending of a weighty body: and the chief thing which the stroke of the atoms giveth unto a dense body, is a determination of the way which a dense body is to cut unto it self: therefore multiplication or lessening of the atoms, will not make any sensible difference betwixt the weight of one dense body where many atoms do strike, and another body of the same density where but a few do strike; so that the stroke downwards of the descending atoms, be greater than the stroke upwards of the ascending atoms; and thereby determineth it to weigh to the centrewards, and not rise floating upwards, which is all the sensible effect we can perceive.

Nxt we may observe, that the first particulars of the objection, do not reach home to enserble our doctrine in this particular, although we admit them to be in such sort as they are proposed: for they do withall imply such a perpetual variation of causes, ever favourable to our position, that nothing can be inferred out of them to repugne against it. As thus: When there are many atoms descending in the air, the same general cause which maketh them be many, maketh them also be light in proportion to their multitude. And so, when they are few they are heavy; likewise when the atoms are light, the aire is rarified and thinne; and when they are heavy the aire is thick; and so upon the whole matter is evident, that we cannot make such a precise and exact judgement

ment of the variety of circumstances, as to be able to determine when there is absolutely more cause of weight, and when less. And as we finde not weight enough in either side of these opposite circumstances to turn the scales in our discourse, so likewise we find the same indifference in experience it self: for the weights we use do weigh equally in misty weather and in clear: and yet in rigor of discourse, we cannot doubt but that in truth they do not gravitate or weigh so much (though the difference be imperceptible to sense) when the air is thick and foggy, as when it is pure and rarified: which thickness of the *medium*, when it arriveth to a very notable degree, as for example to water, maketh then a great difference of a heavy bodies gravitation in it; and accordingly we see a great difference between heavy bodies descending in water and in air; though between two kindes of air none is to be observed, their difference is so small in respect of the density of the body that descendeth in them. And therefore, seeing that an assured and certain difference in circumstances maketh no sensible inequality in the effect; we cannot expect any from such circumstances as we may reasonably doubt whether there be any inequality among them or no.

Besides that, if in any of the proposed cases a heavy body should gravitate more, and be heavier one time than another; yet by weighing it, we could not discern it; since that the counterpoise (which is to determine its weight) must likewise be in the same proportion heavier than it was. And besides weighing, no other means remaineth to discover its greater gravitation, but to compare it to time in its descent: and I believe that in all such distances as we can try it in, its inequalities will be no whit less difficult to be observed that way, than any other.

5. Lastly, to bend our discourse particularly to that instance of the objection; where it is conceived that if gravity or descending downwards of bodies proceeded from atoms striking upon them as they move downwards; it would follow, that a stone or other dense body lying under shelter of a thick, hard, and impenetrable adamantine rock, would have no impulse downwards, and consequently would not weigh there. We may note, that no body whatsoever compacted by Physical causes and agents, can be so dense and imporous, but that such

The reason why the shelter of a thick body doth not hinder the descent of that which is under it.

such atoms, as these we speak of, must be in them, and in every part of them, and every where pass through and through them; as water doth through a sieve or through a sponge: and this universal maxime must extend as far as the sun, or as any other heat communicating with the sun doth reach and is found.

The reason whereof is, because these atoms are no other thing, but such extreme litle bodies as are resolved by heat, out of the main stock of those massie bodies upon which the sun and heat do work. Now then it being certain, out of what we have heretofore said, that all mixt bodies have their temper and consistence, and generation, from the mingling of fire with the rest of the Elements that compose them; and from the concoction or digestion which fire maketh in those bodies, it is evident, that no mixt body whatsoever, nor any sensible part of a mixt body, can be void of pores capable of such atoms, nor can be without such atoms passing through those pores; which atoms by mediation of the air (that likewise hath its share in such pores) must have communication with the rest of the great sea of air, and with the motions that pass in it. And consequently, in all and every sensible part, of any such extreme dense, and pretended impenetrable body, (to the notice whereof we can arrive) this percussion of atoms must be found; and they will have no difficulty in running through; nor by means of it, in striking any other body lying under the shelter of it; and thus both in & from, that hard body, there must be still an uninterrupted continuation of gravity, or of descending towards the center.

Unto which we may add, that the stone or dense body cannot lie so close to the rock that covereth it, but that some air must be between, (for if nothing were between, they would be united, and become one continued body;) and in that air (which is a creek of the great ocean of air spread over the world, that is every where bestrewed with moving atoms; and which is continually fed, like a running stream, with new air that driveth on the air it overtaketh) there is no doubt but there are descending atoms, as well as in all the rest of its main body: and these descending atoms meeting with the stone, must needs give some stroke upon it; and that stroke (be it never so little) cannot chuse but work some effect, in making the stone remove a little that

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way

way they go; and that motion, whereby the space is enlarged, between the stone and the sheltering rock, must draw in a greater quantity of air and atoms to strike upon it. And thus by little and little, the stone passeth through all the degrees of tardity by which a descending body parteth from rest: which is by so much the more speedily done, by how much the body is more eminent in density. But this difference of time, in regard of the atoms strokes onely; and abstracting from the bodies density; will be insensible to us; seeing (as we have said) no more is required of them, but to give a determination downwards.

6. And out of this, we clearly see the reason why the same atoms, striking upon one body lying upon the water, do make it sinke; and upon another they do not. As for example, if you lay upon the superficies of some water, a piece of iron, and a piece of cork, of equal bigness and of the same figure; the iron will be beaten down to the botome, and the cork will float at the top. The reason whereof is, the different proportions of the comparison of their densities with the density of water: for (as we have said) the efficacy and force of descending, is to be measured by that. So then the strokes of the atoms, being more efficacious upon water than upon cork, because the density of water is greater than the density of cork, considering the abundance of air that is harboured in the large pores of it; it followeth, that the atoms will make the water go down more forcibly than they will cork. But the density of iron exceeding the density of water, the same strokes will make the iron descend faster than the water; and consequently, the iron must sinke in the water, and the cork will swim upon it.

And this same is the cause, why if a piece of cork be held by force at the bottom of the water; it will rise up to the top of the water, as soon as the violence is taken away that kept it down: for the atoms strokes having more force upon the water than upon the cork, they make the water sink and slide under it; first, a little thin plate of water; and then another a little thicker; and so by degrees more and more, till it hath lifted the cork quite up to the top.

7. Fifthly, it may be objected, that these atoms do not descend alwaies perpendicularly, but some times slopingly; and in that case, if their strokes be the cause of dense bodies moving, they should

The fifth objection answered concerning

should move sloping, and not downward. Now that these atoms descend sometimes slopingly, is evident, as when (for example) they meet with a stream of water; or with a strong wind, or even with any other little motion of the air, such as carrieth feathers up and down hither and thither; which must needs waite the atoms in some measure along with them their way; seeing then that such a gentle motion of the air is able to put a feather out of its way, notwithstanding the percussions of the atoms upon it; why shall it not likewise put a piece of iron out of its way downwards; since the iron hath nothing from the atoms but a determination to its way? But much more, why should not a strong wind, or a current of water, do it; since the atoms themselves that give the iron its determination must needs be hurried along with them?

To this we answer, that we must consider, how any wind or water which runneth in that sort, is it self originally full of such atoms; which continually, and every where, presse into it and cut through it, in pursuing their constant perpetual course of descending; in such sort, as we shewed in their running through any hard rock, or other densest body. And these atoms do make the wind or the water primarily tend downwards; though other accidental causes impel them secondarily to a sloping motion. And still, their primary natural motion will be in truth strongest; though their not having scope to obey that, but their having enough to obey the violent motion, maketh this become the more observable. Which appeareth evidently out of this; that if there be a hole in the bottom of the pipe that conveyeth water slopingly, be the pipe never so long, and consequently the sloping motion never so forcible; yet the water will run out at that hole to obey its more powerfull impulse to the centerwards, rather than continue the violent motion, in which it had arrived to a great degree of celerity.

Which being so, it is easie to conceive that the atoms in the wind or water which move perpendicularly downwards, will still continue the irons motion downwards, notwithstanding the mediums sloping motion: since the prevailing force determineth both the iron, and the medium downwards; and the iron hath a superproportion of density to cut its way, according as the prevalent motion determineth it.

But if the descending atoms be in part carried along down the stream by the current of wind or water; yet still the current bringeth with it new atoms into the place of those that are carried away; and these atoms, in every point of place wheresoever they are, do of themselves tend perpendicularly downwards; howbeit they are forced from the complete effect of their tendency, by the violence of the current: so that in this case they are moved by a declining motion, compounded of their own natural motion, and of the forced motion, with which the stream carrieth them. Now then if a dense body do fall into such a current where these different motions give their several impulses, it will be carried (in such sort as we say of the atoms; but in another proportion) not in a perpendicular but in a mixt declining line, compounded out of the several impulses, which the atoms and the current do give it (in which also it is to be remembred, how the current giveth an impulse downwards, as well as sloping; and peradventure the strongest downwards;) and the declination will be more or less, according as the violent impulse prevaileth more or less against the natural motion.

But this is not all that is to be considered in estimating the declination of a dense bodies motion when it is sinking in a current of wind or water; you must remember that the dense body it self hath a particular virtue of its own (namely its density) by which it receiveth and prosecuteth more fully its determination downwards; and therefore the force of that body in cutting its way through the medium, is also to be considered in this case, as well as above, in calculating its declining from the perpendicular; & out of all these causes will result a middle declination compounded of the motion of the water or wind both waies, and of its own motion by the perpendicular line. And since of these three causes of a dense bodies motion, its own virtue in prosecuting by its density the determination it requireth, is the most efficacious by much after it hath once received a determination from without; its declination will be but little if it be very dense and heavie: But if it recede much from density, so as to have some neare proportion to the density of the medium, the declination will be great. And in a word, according as the body is heavier or lighter, the declination will be more or less, in the same current though not exactly

exactly according to the proportion of the diminishing of its density, as long as there is a superproportion of its density to the medium: since that such a superproportion (as we have declared heretofore) maketh the mediums operation upon the dense body scarce considerable.

And hence you see why a stone or piece of iron, is not carried out of its way as well as a feather; because the stones motion downwards is greater and stronger than the motion of a feather downwards. And by consequence, the force that can deturn a feather from its course downwards, is not able to deturn a stone. And if it be replied, that it may be so ordered that the stone shall have no motion, before it be in the stream of a river, and notwithstanding it will still move downwards: we may answer, that considering the little declivity of the bed of such a stream, the strongest motion of the parts of the stream, must necessarily be downwards; and consequently, they will beat the stone downwards. And if they do not the like to a feather or other light body; it is because other parts of the stream, do get under the light body, and beat it upwards, which they have not power enough to do to the stone.

Sixthly, it may be objected, that if Elements do not weigh in their own spheres; then their gravity and descending must proceed from some other cause, and not from this percussing of the atoms we attribute to it; which percussing we have determined goeth through all bodies whatsoever, and beatech upon every sensible Part of them. But that Elements weigh not in their own spheres, appeareth out of the experience of a syphon; for though one leg of a syphon, be sunk never so much deeper into the body of the water, than the other leg reacheth below the superficies of the water: nevertheless, if once the outward leg become full of water, it will draw it out of the other longer leg: which it should not do, if the parts of water that are comprised within their whole bulk, did weigh; seeing that the bulk of water is much greater in the sunk leg than in the other, and therefore these should rather draw back the other water into the cistern, than be themselves drawn out of it into the air.

To this we answer, that it is evident the Elements do weigh in their own spheres; at least as far as we can reach to their spheres:

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for

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The sixth objection answered: and that all heavy elements do weigh in their own spheres.

for we see that a ballone stuffed hard with air is heavier than an empty one. Again, more water would not be heavier than less if the inward parts of it did not weigh : and if a hole were digged in the bottome of the sea, the water would not run into it and fill it, if it did not gravitate over it. Lastly, there are those who undertake to distinguish in a deep water, the divers weights which severall parts of it have, as they grow still heavier and heavier towards the bottom : and they are so cunning in this art, that they profess to make instruments which by their equality of their weight to a determinate part of the water, shall stand just in that part, and neither rise nor fall higher or lower: but if it be put lower, it shall ascend to its exact equally weighing orbe of the water ; and if be put higher, it shall descend until it cometh to rest precisely in that place. Whence it is evident, that parts of water do weigh within the bulk of their main body ; and of the like we have no reason to doubt, in the other two weighty Elements.

As for the opposition of the syphon, we refer that point to where we shall have occasion to declare the nature of that engine, of set purpose. And there wee shall shew, that it could not succeed in its operation, unless the parts of water did gravitate in their main bulk, into which one leg of the syphon is sunk.

9.
The seventh
objection answered, and
the reason
why we do
not feel the
course of the
air and atoms
that beat continually upon
us.

Lastly, it may be objected, that if there were such a course of atoms as we say ; and that their strokes were the cause of so notable an effect, as the gravity of heavy bodies ; we should feel it palpably in our own bodies, which experince sheweth us we do not.

To this we answer first, that there is no necessity we should feel this course of atoms, since by their subtilty they penetrate all bodies ; and consequently, do not give such strokes as are sensible. Secondly, if we consider that dusts and straws, and feathers do light upon us without causing any sense in us ; much more we may conceive that atoms (which are infinitely more subtile and light) cannot cause in us any feeling of them. Thirdly, we see that what is continual with us, and mingled in all things, doth not make us take any especial notice of it : and this is the case of the smiting of atoms. Nevertheless peradventure we feel them in truth, as often as we feel hot and cold weather, and in all catarres or other such changes, which do as it were
sink.

sink into our body without our perceiving any sensible cause of them : for no question but these atoms are the immediate causes of all good and bad qualities in the air. Lastly, when we consider that we cannot long together hold out our arm at length, or our foot from the ground, and reflect upon such like impotencies of our resisting the gravity of our own body : we cannot doubt but that in these cases we feel the effect of these atoms, working upon those parts; although we cannot by our sense discern immediately that these are the causes of it.

But now it is time to draw our Reader out of a difficulty, which may peradventure have perplexed him in the greatest part of what he hath hitherto gone over. In our investigation of the Elements, we took for a principle thereunto, That gravity is sometimes more, sometimes less, than the density of the body in which it is. But in our explication of rarity and density, and again in our explication of gravity, we seem to put that gravity and density is all one. This thorn I apprehend, may in all this distance have put some to pain : but it was impossible for me to remedy it; because I had not yet delivered the manner of gravitation. Here then I will do my best, to assuage their grief, by reconciling these appearing repugnancies.

We are therefore to consider, that density (in it self) doth signify a difficulty to have the parts of its subject, in which it is, separated one from another; and that gravity (likewise in it self) doth signify a quality, by which a heavy body doth descend towards the center; or (which is consequent thereunto) a force to make another body descend. Now this power, we have shewed, doth belong unto density, so far forth as a dense body being stricken by another, doth not yeeld by suffering its parts to be divided; but with its whole bulk striketh the next before it, and divideth it, if it be more divisible than it self is. So that you see density hath the name of density, in consideration of a passive quality, or rather of an impassibility which it hath; and the same density is called gravity, in respect of an active quality it hath which followeth this impassibility. And both of them are estimated by the different respects which the same body or subject, in which they are, have unto different bodies that are the terms whereunto it is compared; for the active quality or gravity of a dense body is esteemed by its respect to the body it striketh upon; whereas its

10.

How in the same body, gravity may be greater than density, and density than gravity; though they be the same thing.

density includeth a respect singly to the body that striketh it.

Now it is no wonder that this change of comparison worketh a disparity in the denominations: and that thereby the same body may be conceived to be more or less impartible, than it is active or heavy. As for example, let us of a dense Element take any one least part, which must of necessity be in its own nature and kind absolutely impartible: and yet it is evident that the gravity of this part must be exceeding little by reason of the littleness of its quantity; so that thus you see an extremity of the effect of density, joyned together in one body (by the accident of the littleness of it) with a contrary extremity of the effect of gravity, (or rather with the want of it) each of them within the limits of the same species. In like manner it happeneth, that the same body in one circumstance is more weighty, in another (or rather in the contrary) is more partible: so water when it is in a pail, because it is thereby hindered from spreading abroad, hath the effect of gravity predominating in it; but if it be powred out, it hath the effect of partibility more. And thus it happeneth that merely by the gradation of rarity and density, one dense body may be apt, out of the general course of natural causes, to be more divisible than to be a divider; though according to the nature of the degrees considered absolutely in themselves, what is more powerfull to divide, is also more resistant and harder to be divided. And this arriveth in that degree which maketh water; for the falling and beating of the atoms upon water, hath the power both to divide it and to make it descend; but so, that by making it descend it divideth it. And therefore we say, that it hath more gravity than density, though it be the very density of it, which is the cause that maketh it partible, by the working of one part upon another: for if the atoms did not find the body so dense as it is, they could not by their beating upon one part make another be divided.

So that a dense body to be more heavy than dense, signifieth nothing else, but that it is in such a degree of density, that some of its own parts by their being assisted and set on work by a general cause (which is the fall of the atoms) are powerfull enough to divide other adjoining parts of the same density with them one from another; in such sort as we see that water poured out of an ewer into a basin where there is already other water, hath the power to divide the water in the basin by the assistance

stance of the celerity which it getteth in descending. And now I hope the reader is fully satisfied that there is no contradiction in putting *Density* and *Gravity* to be the same thing materially, and that nevertheless the same thing may be more heavie than dense, or more dense than heavy, as we took it to our several purposes in the investigation of Elements.

Having thus laid an intelligible ground to discover how these motions that are general to all bodies and are natural in chief, are contrived by nature; we will now endeavour to shew that the contrary position is not onely voluntary, but also impossible. Let us therefore suppose that a body hath a quality to move it downwards. And first we shall ask what downwards signifieth: for either it signifieth towards a fixed point of imaginary space; or towards a fixed point of the universe; or towards some movable point. As for the first, who would maintain it must have more imagination than judgment, to think that a natural quality could have an essence determined by a nothing: because we can frame a conceit of that nothing. As for the second, it is very uncertain whether any such point be in a nature: for as for the center of the earth, it is clear that if the earth be carried about, the center of it cannot be a fixed point. Again, if the center signifieth a determinate point in the earth that is the medium of gravity or of quantity, it is changed as often as any dust lighteth unequally upon any one side of the earth, which would make that side bigger than it was: and I doubt a quality cannot have moral considerations to think that so little doth no harm. As for the third position, likewise it is not intelligible how a quality should change its inclination or essence, according to the change that should light, to make now one point, now another, be the center unto which it should tend.

II.
The opinion of gravities being an intrinsic inclination of a body to the center, refuted by reason.

Again, let us consider that a quality hath a determinate essence. Then seeing its power is to move, and to move signifieth to cut the medium it is moved in; it belongeth unto it of its nature to cut so much of such a medium in such a time. So that if no other cause be added but that you take precisely and *in abstracto*, that quality, that medium, & that time; this effect will follow, that so much motion is made. And if this effect should not follow, it is clear that the being able to cut so much of such a medium in such a time, is not the essence of this quality, as it was supposed to be. Dividing then the time and the medium, half the motion should be

be made in half the time, a quarter of the motion in a quarter of the time, and so without end, as far as you can divide. But this is demonstratively impossible, sith hence it is demonstrated, that a moveable coming from rest, must of necessity pass through all degrees of tardity; and therefore by the demonstration cited out of *Galileus*, we may take a part in which this gravity cannot move its body in a proportionate part of time, through a proportionate part of the medium.

21.

The same opinion refuted by several experiences.

But because, in natural Theorems, experiences are naturally required; let us see whether nature giveth us any testimony of this verity, To that purpose we may consider a plummet hanged in a small string from a beam, which being lifted up gently on the one side at the extent of the string, and permitted to fall merely by the power of gravity, it will ascend very near as high on the contrary side, as the place it was held in from whence it fell. In this experiment we may note two things: the first, that if gravity be a quality, it worketh against its own nature in lifting up the plummet, seeing its nature is onely to carry it down. For though it may be answered, that it is not the gravity but another quality called *vis impressa* which carrieth it up: nevertheless it cannot be denied, but that gravity is either the immediate or at least the mediate cause which maketh this *vis impressa*: the effect whereof being contrary to the nature of gravity, it is absurd to make gravity the cause of it: that is, the cause of an essence, whose nature is contrary to its own. And the same argument will proceed though you put not *vis impressa*, but suppose some other thing to be the cause of the plummets remounting, as long as gravity is said to be a quality: for still gravity must be the cause of an effect contrary to its own inclination, by setting on foot the immediate cause to produce it.

The second thing we are to note in this experiment of the plummets ascent is, that if gravity be a quality, there must be as much resistance to its going up, as there was force to its coming down. Therefore there must be twice as much force to make it ascend, as there was to make it descend: that is to say, there must be twice as much force as the natural force of the gravity is: for there must be once as much to equalize the resistance of the gravity; and then another time as much, to carry it

it as far through the same medium in the same time. But it is impossible that any cause should produce an effect greater than it self.

Again, the gravity must needs be in a determinate degree: and the vertue that maketh the plummet remount (whosoever it be) may be put as little as we please: and consequently not able to oversway the gravity alone if it be an intrinsecal quality, and yet the plummet will remount: in which case you put an effect without a cause.

Another experience we may take from the force of sucking; for take the barrel of a long gun perfectly bored, and set it upright, with the breech upon the ground, and take a bullet that is exactly fit for it, but so as it stick not any where (both the barrel and it being perfectly polished;) and then if you suck at the mouth of the barrel (though never so gently) the bullet will come up so forcibly, that it will hazard the striking out of your teeth. Now let us consider what force were necessary to suck the bullet up, and how very slowly it would ascend, if in the barrel it had as much resistance to ascend, as in the free air it hath inclination to go down. But if it had a quality of gravity natural to it, it must of necessity have such resistance: whereas in our experiment we see it cometh as easily as the very air. So that in this example, as well as in the other, nature teacheth us that gravity is no quality.

And all or most of the arguments which we have urged against the quality of gravity in that explication we have considered it in, have force likewise against it, although it be said to be an inclination of its subject to move it self unto unity with the main stock of its own nature, as divers witty men do put it: for this supposition doth but change the intention or end of gravity: and is but to make it another kind of intellectual or knowing Entity, that determineth it self to another end: which is as impossible for a natural quality to do, as to determine it self to the former ends. And thus much the arguments we have proposed do convince evidently, if they be applyed against this opinion.

CHAP. XII.

Of Violent Motion.

1.
The state of
the question
touching the
cause of vio-
lent motion.

AND thus we have given a short scantling, whereby to understand in some measure the causes of that motion which we call natural, by reason it hath its birth from the universal oeconomy of nature here among us; that is, from the general working of the sun, whereby all natural things have their course: and by reason that the cause of it is at all times and in all places constantly the same. Next unto which the order of discourse leadeth us to take a survey of those forced motions, whose first causes the more apparent they are, the more obscurity they leave us in to determine by what means they are continued.

When a tennis-ball is stricken by a racket, or an arrow is shot from a bow, we plainly see the causes of their motion: namely the strings, which first yielding, and then returning with a great celerity, do cause the missives to speed so fast towards their appointed homes. Experience informeth us what qualities the missives must be endued withall to move fast and steadily. They must be so heavy that the air may not break their course; and yet so light, that they may be within the command of the stroke which giveth them motion; the striker must be dense, and in its best velocity: the angle which the missive is to mount by (if we will have it go to its furthest randome) must be the half of a right one: and lastly, the figure of the missive must be such, as may give scope unto the air to bear it up, and yet not hinder its course by taking too much hold of it. All this we see; but when withall we see that the mover deserteth the moveable as soon as he hath given the blow; we are at a stand, and know not where to seek for that which afterwards maketh it flie: for motion being a transient, not a permanent thing, as soon as the cause ceaseth that begot it, in that very point it must be at an end; and as long as the motion continueth, there must be some permanent cause to make it do so: so that as soon as the racket or bowstring go back and leave the ball or arrow, why should not they presently fall straight down to the ground?

2.
That the me-
dium is the
only

Aristotle and his followers have attributed the cause hereof to the air: but *Galileo* relisheth not this conception. His argu-
ments

ments against it, are (as I remember) to this tenour : first, air by reason of its rarity and divisibility, seemeth not apt to conserve motion : next, we see that light things are best carried by the air ; and it hath no power over weighty ones : lastly, it is evident that air taketh most hold of the broadest superficies ; and therefore an arrow would flie faster broad waies than long waies, if this were true. Nevertheless, since every effect must have a proportionable cause from whence it immediately floweth ; and that a body must have another body to thrust it on as long as it moveth ; let us examine what bodies do touch a moveable whilst it is in motion, as the onely means to find an issue out of this difficulty ; for to have recourse unto a quality or impressed force for deliverance out of this freight, is a shift that will not serve the turn in this way of discourse we use. In this Philosophy no knot admitteth such a solution.

cause, which
continueth
violent motion.

If then we inquire what body it is that immediately toucheth the ball or arrow whilst it flieth ; we shall find that none other doth so but the air and the atoms in it, after the strings have given their stroke, and are parted from the missive. And although we have *Galileos* authority, and arguments to discourage us from believing that the air can work this effect ; yet since there is no other body besides it left for us to consider in this case, let us at the least examine how the air behaveth it self after the stroke is given by the strings. First then it is evident that as soon as the racket or bowstring shrinketh back from the missive, and leaveth a space between the missive and it (as it is clear it doth, as soon as it hath stricken the resisting body) the air must needs clap in with as much velocity as they retire, and with somewhat more ; because the missive goeth forward at the same time, and therefore the air must hasten to overtake it, lest any vacuity should be left between the string and the arrow. It is certain likewise, that the air on the sides doth also upon the division of it, slide back and help to fill that space which the departed arrow leaveth void. Now this forcible closing of the air at the nock of the arrow, must needs give an impulse or blow upon it : if it seem to be but a little one, you may consider how it is yet much greater, than what the air and the bodies swimming in it, do at the first give unto a stone falling from high ; and how at the last those little atoms that drive a
stone.

stone in its natural motion, do with their little blows force it peradventure more violently & swiftly than any impelling agent we are acquainted with can do. So that the impulse which they make upon the arrow, pressing violently upon it after such a vehement concussion, and with a great velocity, must needs cause a powerfull effect in that which of it self is indifferent to any motion any way.

3.
A farther explication of the former doctrine.

But unless this motion of the air do continue to beat still upon the arrow, it will soon fall to the ground, for want of a cause to drive it forward; and because the natural motion of the air (being then the onely one) will determine it downwards. Let us consider then how this violent rending of the air by the blow that the bow-wring giveth unto the arrow, must needs disorder the little atoms that swim to and fro in it, and that (being heavier than the air) are continually descending downwards. This disorder maketh some of the heavier parts of them, get above others that are lighter than they; which they not abiding, do press upon those that are next them, and they upon their fellows: so that there is a great commotion and undulation caused in the whole mass of air round about the arrow: which must continue some time before it can be settled: and it being determined by the motion of the arrow that way that it slideth, it followeth, that all this commotion and undulation of the air, serveth to continue the arrow in its flight. And thus faster than any part behind can be settled, new ones before are stirred, till the resistance of the medium do grow stronger than the impulse of the mover.

Besides this, the arrow pressing upon the air before it, with a greater velocity than the air (which is a liquid rare body) can admit, to move all of a piece without breaking: it must of necessity happen that the parts of the air immediately before the arrow be driven upon others farther off, before these can be moved to give place unto them; so that in some places the air becometh condensed, and consequently in others rarified. Which also the wind that we make in walking (which will shake a paper pinned loosely at the wall of a chamber towards which we walk) and the cooling air caused by fanning when we are hot do evidently confirm. So that it cannot be doubted, but that condensation and rarefaction of the air must necessarily follow the

the motion of any solid body: which being admitted, it is evident that a great disorder, and for some remarkable time, must necessarily be in the air; since it cannot brook to continue in more rarity or density than is natural unto it. Nor can weighty and light parts agree to rest in an equal height or lowness; which the violence of the arrows motion forceth them unto for the present. Therefore it cannot be denied, but that though the arrow slide away, nevertheless there still remaineth behind it (by this condensation and confusion of parts in the air) motion enough to give impulse unto the arrow, so as to make it continue its motion after the bow-string hath left it.

But here will arise a difficulty: which is, how this clapping in and undulation of the air should have strength and efficacy enough to cause the continuance of so smart a motion, as is in arrows shot from a bow. To this I need no other argument for an answer than to produce *Galileos* testimony, how great a body one single mans breath alone can in due circumstances give a rapid motion unto: and withall, let us consider how the arrow and the air about it are already in a certain degree of velocity; that is to say, the obstacle that would hinder it from moving that way (namely, the resistance of the air) is taken away; and the causes that are to produce it (namely the determining of the aires, and of the atoms motion that way) are heightened; And then we may safely conclude, that the arrow which of itself is indifferent to be moved upwards or downwards, or forwards, must needs obey that motion which is caused in it by the atoms, and the aires pressing upon it; either according to the impulse of the string, or (when the string beginneth to flag) according to the beatings that follow the general constitution of nature; or in a mixt manner according to the proportions that these two hold to one another. Which proportions *Galileus* in his 4. Dialogue of motion hath attempted to explicate very ingeniously: but having mist in one of his suppositions; to wit, that forced motion upon an horizontal line, is throughout uniform; his great labours therein have taken little effect towards the advancing the knowledge of nature, as he pretended: for his conclusions succeed not in experience, as *Mersenius* assureth us after very exact trials; nor can they in their reasons be fitted to nature.

So that to conclude this point, I find no difficulty in allowing this

4.

That the air hath strength enough to continue violent motion in a moveable. Dial. 4. of motion, pag. 98.

this motion of the air strength enough to force the moveable onwards, for some time after the first mover is severed from it; (and long after, we see no motions of this nature do endure:) so that we need seek no farther cause for the continuance of it: but may rest satisfied upon the whole matter, that since the causes and circumstances our reason suggesteth unto us, are after mature and particular examination proportionable to the effects we see, the doctrine we deliver must be sound and true.

5. For the establishing whereof, we need not (considering what we have already said) spend much time in solving *Galileos* arguments against it: seeing that, out of what we have set down, the answers to them appear plain enough; for first we have assigned causes how the air may continue its motion long enough to give as much impression as is needfull unto the arrow, to make it go on as it doth. Which motion is not requisite to be near so great in the air behind the arrow (that driveth it on) as what the arrow causeth in the air before it: for by reason of the density of it, it must needs make a greater impression in the air it cutteth, than the air that causeth its motion, would do of it self without the mediation of the arrow. As, when the force of a hand giveth motion unto a knife to cut a loaf of bread, the knife, by reason of the density and of the figure it hath maketh a greater impression in the loaf, than the hand alone would do. And this is the same that we declared in the natural motion of a heavie thing downwards, unto which we assigned two causes; namely, the beating of the atomes in the air, falling down in their natural course, to determine it the way it is to go; and the density of the body, that cutting more powerfully than those atoms can do, giveth (together with their help) a greater velocity unto the moveable, than the atoms of themselves can give.

Nor doth it import that our resolution is against the general nature of rare and dense bodies, in regard of conserving motion; as *Galileo* objecteth: for the reason why dense bodies do conserve motion longer than rare bodies, is because in regard of their dividing virtue, they get in equal times a greater velocity. Wherefore seeing that velocity is equal unto gravity; it followeth, that resistance worketh not so much upon them as upon rare bodies; and therefore cannot make them cease from motion

tion so easily as it doth rare bodies. This is the general reason for the conservation of motion in dense bodies. But because in our case, there is a continual cause which conserveth motion in the air, the air may continue its motion longer than of it self it would do: not in the same part of air which *Galileus* (as it seemeth) did aim at: but in divers parts, in which the movable successively is.

Which being concluded, let us see how the forced motion cometh to decrease and to be ended. To which purpose we may observe that the impression which the arrow receiveth from the air that driveth it forwards, being weaker than that which it received at the first from the string, (by reason, that the air is not so dense, and therefore cannot strike so great a blow) the arrow doth not in this second measure of time, (wherein we consider the impulse given by the air onely) cut so strongly the air before it, nor press so violently upon it, as in the first measure: when the string parting from it did beat it forwards: for till then the velocity encreaseth in the arrow, as it doth in the string that carrieth it along, which proceedeth from rest at the fingers loose from it, to its highest degree of velocity; which is, when it arriveth to the utmost extent of its jerk, where it quitteth the arrow. And therefore, the air now doth not so swiftly, nor so much of it, rebound back from before, and clap it self behind the arrow, to fill the space that else would be left void by the arrows moving forward, and consequently the blow it giveth in the third measure, to drive the arrow on, cannot be so great as the blow was immediately after the strings parting from it; which was in the second measure of time: and therefore the arrow must needs move slower in third measure than it did in the second; as formerly it moved slower in the second (which was the air's first stroke) then it did in the first, when the string drove it forwards. And thus successively in every moment of time, as the causes grow weaker and weaker by the increase of resistance in the air before, and by the decrease of force in the subsequent air; so the motion must be slower and slower, till it come to pure cessation.

As for *Galileus* second argument; that the air hath little power over heavy things; and therefore he will allow it to be the cause of continuing forced motions in dense bodies: I wish he could as well have made experience what velocity of motion heavy bodies.

6.

An answer to the second objection that the air hath no power over heavy bodies.

a

a mans breath might produce in an heavy bullet lying upon an even, hard, and slippery plain, (for a table would be too short) as he did, how admirable great a one it produced in pendants hanging in the air : and, I doubt not but he would have granted it as powerfull in causing horizontal motions, as he found it in the undulations of his pendants. Which nevertheless, do sufficiently convince how great a power air hath over heavy bodies. As likewise the experience of wind-guns assureth us that air duly applied is able to give greater motion unto heavy bodies than unto light ones. For how can a straw or feather be imagined possibly to fly with half the violence as a bullet of lead doth out of one of those engines ? And when a man sucketh a bullet upwards in a perfectly bored barrel of a gun, which the bullet fitteth exactly (as we have mentioned before) with what a violence doth it follow the breath and ascend to the mouth of the barrel ? I remember to have seen a man that was uncautious and sucked strongly that had his foreteeth beaten out by the blow of the bullet ascending.

This experiment (if well looked into may peradventure make good a great part of this doctrine we now deliver. For, the air pressing in behind the bullet at the touch-hole, giveth it its impulse upwards; unto which the density of the bullet being added, you have the cause of its swiftness and violence ; (for a bullet of wood or cork, would not ascend so fast and so strongly) and the sucking away of the air before it, taketh away that resistance which otherwise it would encounter with by the air lying in the way of it: and its following the breath with so great ease, sheweth (as we touched before) that of it self it is indifferent to any motion, when nothing presseth upon it to determine it a certain way.

7. Now to *Galileos* last argument, that an arrow should fly faster broad-waies, than long-waies, if the air were cause of its motion : there needeth no more to be said, but that the resistance of the air before hindreth it as much as the impulse of the air behind helpeth it on ; so that nothing is gained in that regard; but much is lost, in respect of the figure ; which maketh the arrow unapt to cut the air so well when it flieth broad-waies, as when it is shot long-waies : and therefore the air being weakly cut, so much of it cannot clap in behind the arrow and drive it on, against the resistance before which is much greater.

Thus far with due respect, and with acknowledging remem-

An answer to the third objection, that an arrow should fly faster broad waies, than long-waies.

brance of the many admirable mysteries of nature which that great man hath taught the world, we have taken liberty to dispute against him: because this difficulty seemeth to have driven him against his Genius, to believe that in such motions there must be allowed a quality imprinted into the moved body to cause them: wch our whole scope both in this, and in all other occasions where like qualities are urged, is to prove them superfluous and ill grounded in nature; and to be but meer terms to confound & leave in the dark whosoever is forced to fly unto them.

CHAP. XIII.

Of three sorts of violent motion, Reflection, Undulation, and Refraction.

THe motion we have last spoken of, because it is ordinarily either in part or wholly contrary to gravity (which is accounted the natural motion of most bodies) useth to be called violent or forced. And thus you have delivered unto you the natures and causes both of natural and of forced motion; yet it remaineth that we advertise you of some particular kinds of this forced motion, which seem to be different from it, but indeed are not. As first, the motion of reflection; which if we do but consider how forced motion is made; we shall find that it is nothing else but a forced motion, whose line whereupon it is made, is as it were snapped in two by the encounter of a hard body. For even as we see in a spout of water that is strongly shot against a wall, the water following driveth the precedent parts first to the wall, and afterwards coming themselves to the wall, forceth them again another way from the wall: right so, the latter parts of the torrent of air, which is caused by the force that occasioned the forced motion, driveth the former parts, first upon the resistant body, and afterwards again from it. But this is more eminent in light than in any other body, because light doth less resist gravity; and so observeth the pure course of the stroke, better than any other body; from which others do for the most part decline some way by reason of their weight.

Now the particular law of reflexion is, that the line incident, & the line of reflexion must make equal angles with that line of the resistant superficies wch is in the same superficies with themselves. The demonstration whereof, that great wit *Renatus Des Cartes* hath

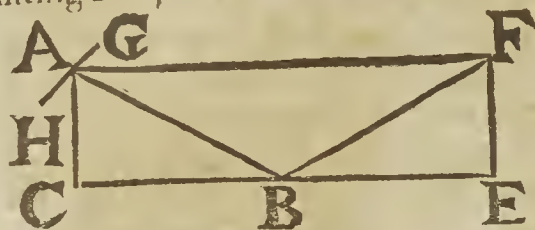
1.

That reflexion is a kind of violent motion.

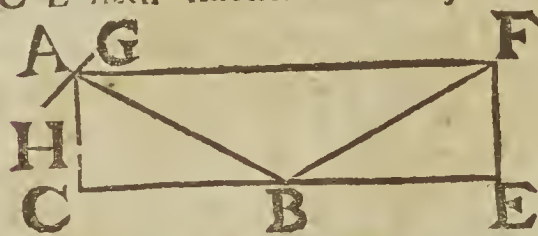
2.

Reflexion is made at equal angles.

hath excellently set down in his book of Dioptricks by the example of a ball stricken by a racket against the earth, or any resisting body: the substance whereof is as followeth.



In the Rectangle Parallelogramme A E, let C E be the superficies of the Earth: A, the point from which the racket H G, striketh the Ball by the line A B, to the point B in the superficies of the earth: and let us consider C, to be on the left hand, and E on the right. Now we are to shew that the Ball will rebound by the line B F, to the point F, in the same time in which it went from A to B; and to make the angle A B C equal to the angle F B E. For the effecting whereof, we must abstract, according to the manner of Mathematicians, from all Physical inequalities, and suppose the superficies C E, to be Mathematically plain, and the force of the racket to continue equally strong in B as it is in A, for although in truth, neither of these be rigorously so; nevertheless, because there is no sensible defect in any operation that dependeth on them, it is the same to our purpose as if they were Mathematically so. We see then that the racket H G, doth in a certain time drive the ball from A to B; that is to say, from the left hand to the right, as far as from C to B; and from above to downwards as far as from A to C. We see again, that the superficies C E, is not contrary unto this motion of the ball, as it goeth from the left hand to the right; for the line C E lieth likewise that way: but is contrary unto it, as it



goeth from above downwards; for in that course the superficies C E encountereth and putteth a period to the line A C. And therefore the motion of the ball when it meeteth with the superficies C E, must be changed from the line A C, so much as the superficies C E is contrary unto it; that is quite backwards as far as it dependeth of that opposition. Therefore, when the ball is come to B, it must go from thence in the same proportion of left hand to right hand, and from below upwards, as it came before from left hand to right

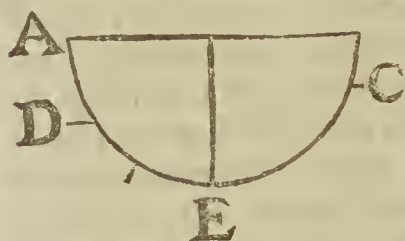
hand, and from above downwards, when it came from A to B. And consequently, it must in equal time have passed another line from left hand to right hand, as long as the line C B; and likewise, it must at the same time have passed another line from below upwards, as long as A C: which will of necessity make it hit in the point F, at the end of so much more time as it spent in going from A to B; and so, make the two angles A B C and F B E equal; as every one knoweth that hath but saluted *Euclide*.

The motion which we call undulation needeth no farther explication: for it is manifest, that since a pendant, when it is removed from its perpendicular, will restore it self therunto by the natural force of gravity, and that in so doing it gaineth a velocity, (and therefore cannot cease on a suddain,) it must needs be carried, out of the force of that motion, directly the contrary way: until the force of gravity overcoming the velocity, it must be brought back again to the perpendicular: which being done likewise with velocity, it must send it again towards the place from which it fell at the first. And in this course of motion it must continue for a while, every undulation being weaker than other, until at last it quite ceaseth, by the course of nature settling the air in its due situation according to the natural causes that work upon it. And in this very manner also is performed that undulation which we see in water, when it is stirred from the natural situation of its spherical superficies.

Galileo hath noted that the time in which the undulations are made which follow one another of their own accord, is the same in every one of them; and that as much time precisely is taken up in a pendants going a very short arch towards the end of its vibration, as was in its going of the greatest arch at the beginning of its motion. The reason whereof seemeth strange to him, and he thinketh it to be an accident natural to the body out of its gravity; and that this eff. & convinceth, it is not the air which moveth such bodies. Whereas in truth, it is clearly the air which causeth this eff. &. Because the air striving at each end (where it is furthest from the force of the motion) to quiet it self, getteth at every bout somewhat upon the space; and so contracteth that into a shorter arch.

But it is a great wonder to me, that *Galileo* should make a wonder

wonder of this effect to the reason which he hath laid so fair a foundation upon another occasion, had he but reflected upon it. For in his fourth dialogue of motion he hath demonstrated that a natural movable descending in the quarter of a circle, from what part soever it beginneth, spendeth equal time to come to the lowest point, as if it came from any other part: so that a pendant being brought up to any height by the force of a former motion downwards, it will be sure to spend as much time in going down from thence to the perpendicular, as it did at the first when it was let fall from the greatest height. Now I subsume, that the pendants ascending, being the effect of the velocity of its motion gained in descending immediately before; the said velocity must be able to carry it in the same time to a height, that is proportionate to that height unto which the velocity gained in the first fall did cause the pendant to mount. As



for example, if the pendants first descent were from A to E, the second from C to E; because the time of those two is the same, (as *Galileus* hath demonstrated) it followeth that their velocities gained in descending must of necessity be in the

proportion of the line A E to the line C E: therefore, their effects also must be proportionable. Let us then put the line E D in that proportion to the line C E, which C E hath to A E, and then the velocity gained in C E will carry the pendant up from E to D, in the same time in which the descent A E did carry it up the other way from E to C: wherefore, seeing that the times of its descent from A to E, and from C to E are equal; likewise, the two vibrations from A to C and from C to D will be done in equal times. But that which made *Galileo* not see the force of the consequence, was that he did not acknowledge violent motion to be made in the same proportions; and for the same reasons which are found in natural motion: which we have above shewed to be so, where we discoursed of that matter.

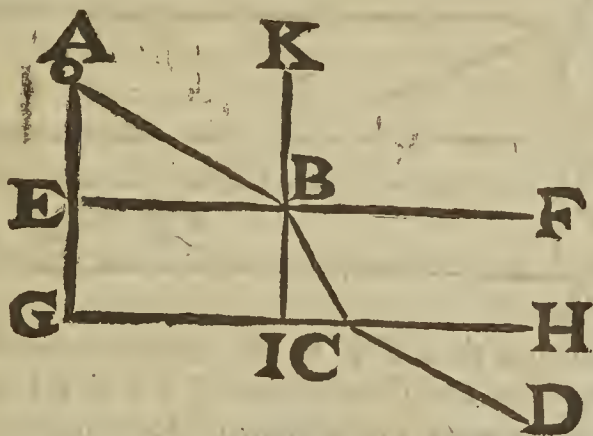
4.
Refraction at
the entrance
into the reflecting
body is

That motion also which we call *Refraction*, and is manifest to sense, only in light; (though peradventure hereafter more diligent searchers of nature, may likewise finde it in such other bodies as are called qualities; as in cold or heat, &c.) is but a kind

kind of Reflexion : for there being certain bodies, in which the passages are so well ordered with their resistances, that all the parts of them seem to permit light to passe through them, and yet all parts of them seem to reflect it ; when light passeth through such bodies, it findeth at the very entrance of them, such resistances where it passeth, as serve it for a reflectent body ; and yet such a reflectent body, as hindereth not the passage through ; but onely hindereth the passage from being in a straight line with the line incident. Wherefore the light must needs take a ply as beaten from those parts towards a line drawn from the illuminant, falling perpendicularly upon the resisting superficies ; and therefore is termed by Mathematicians, to be refracted or broken towards the perpendicular. Now at the very going out again of the light, the second superficies (if it be parallel to the former) must needs upon a contrary cause, strike it the contrary way : which is termed from the perpendicular.

As for example : if the ray AB, lighteth upon the superficies EBF, and findeth entrance ; it is not now the superficies EF, that resisteth or reflecteth it : but it is that part of the inside (as we may say) of the pore B, which is towards F ; and is a Physical body, not a Mathematical point. The reflexion therefore must be made, as if the reflectent body were IBK : but it is evident that if AB, did strike upon IK, it would reflect towards AG. But because we know not the inclination of the superficies IK, whether it be truly a perpendicular or no, therefore we cannot tell the quantity of the inclination which this reflexion must make ; but onely we know that it must be towards AG.

But before we wade any deeper into this difficulty, we cannot omit a word of the manner of explicating refraction which Monsieur Des Cartes useth, so witty a one I am sorry it wanteth success. He therefore following the demonstration above

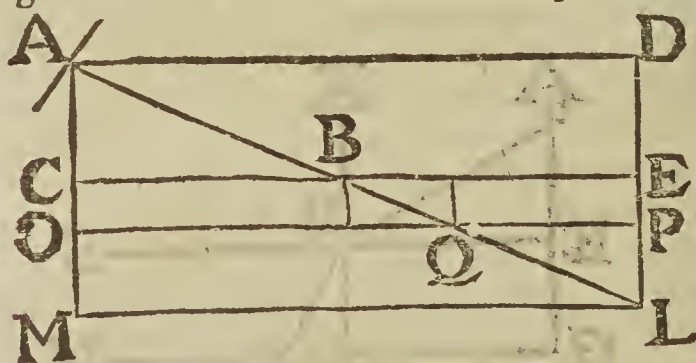


5.

A refutation of
Monsieur Des
Cartes his ex-
plication of
refraction.

given of reflexion; suppose the superficies which a ball lighteth upon, to be a thin linen cloth, or some other such matter as will break cleanly by the force of the ball striking smartly upon it. And because that superficies resisteth onely one way, therefore he inferreth that the velocity of the ball is lessened only one way and not the other: so that the velocity of its motion that way in which it findeth no resistance, must be (after the balls passage through the linen) in a greater proportion to the velocity which it hath the other way where it findeth resistance, than it was before. And therefore the ball will in less time arrive to its period on the one side than on the other: and consequently, it will lean towards that side, unto which the course wherein it findeth no opposition doth carry it.

But how much he is mistaken upon the whole matter a little figure will shew: let us therefore put a Rectangle Parallelogram as before



graph as before A E, which I double & make the whole Parallelogram A L, and draw out the line A B, till it cometh to L. Now we must

imagine that C E is the cloath or passable superficies which *Monsieur Des Cartes* putteth; and B L the line it would go in, if there were no resistance. Next we must seek the perpendicular, which according to our explication, is A C: for that falleth from A the illuminant, perpendicularly upon C E; although, some who defend *Monsieur Des Cartes*, seem to make another line the perpendicular; against the conception of all those that write of Opticks. But, not to trouble our selves with terms; the question is, whether the ball that passeth the cloth, must (after its passage through) deflect from the line B L, (which it would have kept, had there been no resistance) towards E; or else deflect from that line towards C. And both experience and reason do assure us, that it must turn towards C: but *Monsieur Des Cartes* saith towards E.

Which to shew how it is contrary unto his own principle; let us,

us conceive the cloth C E to be of some thickness, and so draw the line O P to determine that thickness, And let us make from B upon A L, another Parallelogram like the Parallelogram A L, whose diameter shall be B Q. And it must necessarily follow that the motion from B to Q, if there were no resistance, were in the same proportion as from A to B. But the proportion of the motion from A to B, is the proportion of C B to C A; that is, it goeth in the same time faster towards D, than it doth towards M, in the proportion which C B hath to C A. By which account, the resistance it hath in the way towards D, must also be greater than the resistance it hath in the way towards M, in the proportion which C B hath to C A; and therefore the more tardity must be in the way to D, and not in the way to M; and consequently, the declination must be from E wards, and to M wards. For where there is most resistance, that way likewise must the tardity be greatest, & the declination must be from that way: but which way the thickness, to be passed in the same time, is most, that way the resistance is greatest: and the thickness is clearly greater towards E, than towards M; therefore, the resistance must be greatest towards E; & consequently the declination from the line B L must be towards M, and not towards E.

But the truth is, that in his doctrine the ball would go in a straight line as if there were no resistance; unless peradventure towards the contrary side of the cloth, at which it goeth out into the free air: for as the resistance of the cloth is greater in the way towards D, than in the way towards M, (because it passeth a longer line in the same time, as also it did formerly in the air) so likewise is the force that moveth it that way greater than the force which moveth it the other. And therefore the same proportions that were in the motion, before it came to the resisting passage, will remain also in it: at the least until coming neer the side at which it goeth out, the resistance be weakened by the thinness of the resistant there: which because it must needs happen on the side that hath least thickness, the ball must consequently turn the other way, where it findeth greatest yielding: and so at its getting out into the free air, it will bend from the greater resistance, in such manner as we have said above.

Neither do the examples brought by *Monsieur Des Cartes* and others in maintenance of this doctrine any thing avail them:

An answer to
the arguments
brought in fa-
vour of *Mon-*
sieur Des Cartes
his opinion.

them: for when a canon bullet shot into a river, hurteth the people on the other side; it is not caused by refraction, but by reflexion, as *Monsieur Des Cartes* himself acknowledgeth: and therefore, hath no force to prove any thing in refraction; whose laws are divers from those of pure reflexion.

And the same answer serveth against the instance of a musket bullet shot at a mark under water; which perpetually lighteth higher than the mark, though it be exactly just aimed at. For we knowing that it is the nature of water, by sinking in one place to rise round about, it must of necessity follow that the bullet which in entering hath pressed down the first parts of the water, hath withall thereby put others farther off in a motion of rising: and therefore the bullet in its going on must meet with some water swelling upwards: and must from it receive a ply that way, which cannot fail of carrying it above the mark it was levelled at. And so we see this effect proceedeth from reflexion or the bounding of the water, and not from refraction. Besides that, it may justly be suspected the shooter took his aim too high, by reason of the marks appearing in the water higher than in truth it is: unless such false aiming were duly prevented.

Neither is *Monsieur Des Cartes* his excuse to be admitted, when he saith that light goeth otherwise than a ball would do, because that in a glass or in water, the ethereal substance which he supposeth to run through all bodies, is more efficaciously moved than in air: and that therefore light must go faster in the glass than in the air, and so turn on that side of the straight line which is contrary to the side that the ball taketh, because the ball goeth not so swiftly. For (not to dispute of the verity of this proposition) the effect he pretendeth is impossible: for if the ethereal substance in the air before the glass be slowly moved, (the motion of which he calleth light) it is impossible that the ethereal substance in the glass or in the water should be more smartly moved than it. Well it may be less; but without all doubt the impulse of the ethereal substance in the glass cannot be greater than its adequate cause, which is the motion of the other parts that are in the air precedent to glass.

Again, after it is passed the glass, it should return to be a straight line with the line that it made in the air precedent to the glass: seeing that the subsequent air must take off just as much (and no more) as the glass did add: the contrary whereof experience sheweth us.

Thirdly

Thirdly, in this explication it would alwaies go one way in the air, and another way in the glass: whereas all experience testifieth, that in a glass convex on both sides, it still goeth in the air after its going out to the same side as it did in the glass; but more. And the like happeneth in glasses on both sides concave. Wherefore it is evident, that it is the superficies of the glass that is the worker on both sides; and not the substance of the air on the one side, and of the glass on the other.

And lastly, his answer doth no way solve our objection, which proveth that the resistance both waies is proportionate to the force that moveth, and by consequence that the thing moved must go straight. As we may imagine would happen if a bullet were shot sloping through a green mud wall, in which there were many round sticks so thin set that the bullet might passe with ease through them; for as long as the bullet touched none of them (which expresth his case) it would go straight; but if it touched any of them (which resembleth ours, as by and by will appear) it would glance according to the quality of the touch, and move from the stick in another line.

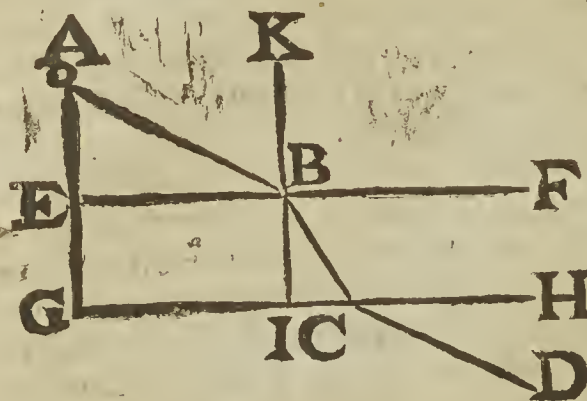
Some peradventure may answer for *Monsieur Des Cartes* that this subtile body which he supposeth to run through all things is stiff and no waies pliable. But that is so repugnant to the nature of rarity, and so many insuperable inconveniencies do follow out of it; as I cannot imagine he will own it; and therefore I will not spend any time in replying thereunto.

We must therefore seek some other cause of the refraction of light, which is made at the entrance of it into a diaphanous body. Which is plainly (as we said before) because the ray striking against the inside of a body it cannot penetrate, turneth by reflexion towards that side on which the illuminant standeth: and if it findeth clear passage through the whole resistant, it followeth the course it first taketh; if not, then it is lost by many reflexions to and fro.

And that this doctrine is true, the accidents or Phenomenas evidently declare unto us; for experience teacheth us, that upon a plain superficies the refraction is made towards the perpendicular drawn from the illuminant to the superficies; as we have said. Now at the going out (if the surfaces be parallels) we see that the ray turneth from that perpendicular; which also is necessary.

7.
The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.

cessary; for going through a pore bigger than it self, or at the least as big; and finding it full of air, it must needs be crowded there. But in a crowd, he presseth you most whom you press most upon: so then that side of the pore which is next to the light as it



passeth, must press most upon it: but the angle which is towards the perpendicular, to wit, the angle BCI, is the lesser; and by consequence, the ray is nearer that side of the pore which is towards I, than the other side of it which is towards H; wherefore it must take its p'y

from that side. But that side striketh it from the perpendicular: and therefore it must there refract from the perpendicular.

This very same doctrine for the reason of refraction is confirmed by what happeneth in crooked superficieses. As if EF



be a *Lens* or a glass on both sides convex; and CB the axis of it; AD the ray falling from the illuminant A; AB the perpendicular falling from the same illuminant A: it will be plain by the former discourse, that the ray AD, must at the entry be refracted towards AB, as being repulsed from that part of the inside of the pore D, which is towards F; because that side is most opposed unto the ray. Now the ray being once turned that way; when at the end of its journey through the glass

glass, it is come to the other superficies EGF, it maketh the lesser angle towards F; and therefore must it by the rule given above be refracted again at its parting from the glass, towards the same perpendicular; and it will meet somewhere with the axis CB; all which experience sheweth us to be true.



And taking a body of concave surfaces we shall (according to this doctrine of ours) finde the causes of refraction just contrary; and accordingly experience likewise sheweth us the effects to be so too. And therefore since experience agreeth exactly with our rules, we cannot doubt but that the principles upon which we go are well laid.

But because crooked ^{8.} surfaces may have many irregularities; it will not be amisse to give a rule by which all of them may be brought unto a certainty. And this it is, that reflexions from crooked

A general rule to know the nature of reflexions and refractions in all sorts of surfaces.

superficies are equal to the reflexions that are made from such plain superficieses, as are tangents to the crooked ones in that point from whence the reflexions are made. Which principle the Masters of the Opticks do take out of a Mathematical supposition of the unity of the reflecting point, in both the surfaces; the crooked and the plain: but we take it out of the insensibility of the difference of so little a part in the two different surfaces, as serveth to reflect a ray of light: for where the difference is insensible in the causes, there likewise the difference is so little in the effects, as sense cannot judge of them: which is as much as is requisite to our purpose. Now seeing that in the Mathematical supposition, the point where the reflection is made is in-

different

different to both the surfaces: it followeth, that it importeth not whether superficies you take to know the quality of reflexion by. This principle then being settled, that the reflexion must follow the nature of the tangent surfaces, and it being proved, that in plain surfaces it will happen in such sort as we have explicated, it followeth that in any crooked superficies of what figure soever the same also will happen.

Now seeing we have formerly declared, that refractions are but a certain kinde of reflexions, what we have said hereof reflexions may be applied to refractions.

9.
A body of greater parts and greater pores maketh a greater refraction than one of lesser parts and lesser pores.

But there remaineth yet untouched one affection more of refractions; which is that some diaphanous bodies do in their inwards parts reflect more than others, (which is that which we call refraction) as experience sheweth us: concerning which effect, we are to consider that diaphanous bodies may in their composition have two differences: for some are composed of greater parts and greater pores; others, of lesser parts and lesser pores. It is true there may be other combinations of pores and parts, yet by these two the rest may be esteemed. As for the first combination, we see that because the pores are greater, a greater multitude of parts of light may passe together through one pore; and because the parts are greater, likewise a greater multitude of raies may reflect from the same part, and may finde the same passage quite throughout the diaphanous body. On the contrary side in the second combination where both the pores and the parts of the diaphanous body are little, the light must be but little that findeth the same passage.

Now that refraction is greater or lesser happeneth two waies: for it is either when one diaphanous body reflecteth light at more angles than another, and by consequence in a greater extent of the superficies; or else when one body reflecteth light from the same point of incidence in a shorter line and in a greater angle than another doth. In both these waies it is apparent that a body composed of greater parts and greater pores, exceedeth bodies of the opposite kinde: for by reason that in the first kind more light may beat against one part; a body in which that happeneth, will make an appearance from a farther part of its superficies: whereas in a body of the other sort, the light that beateth against one of the little parts of it will be so little as it will

will presently vanish. Again, because in the first, the part at the incidence is greater; the surface from which the reflexion is made inwards, hath more of a plain and straight superficies: and consequently doth reflect at a greater angle, than that, whose superficies hath more of inclining.

But we must not pass from this question, without looking a little into the nature of those bodies in which refraction is made: for if they, as well as the immediate causes of refraction, do likewise favour us; it will not a little advance the certainty of our determination. To this purpose we may call to mind, how experience sheweth us that great refractions are made in smoak, and in mists, and in glasses, and in thick-bodied waters; and *Monsieur Des Cartes* addeth certain oyls, and spirits or strong waters.

Now most of these we see are composed of little consistent bodies, swimming in another liquid body. As is plain in smoak and mists: for the little bubbles which rise in the water before they get out of it; and that are smoak when they get into the air; do assure us that smoak is nothing else, but a company of little round bodies, swimming in the air: and the round consistence of water upon herbs, leas, and twigs in a rind or dew, giveth us also to understand that a mist is likewise a company of little round bodies that sometimes stand, sometimes float in the air, as the wind driveth them. Our very eyes bear witness to us, that the thicker sort of waters are full of little bodies, which is the cause of their not being clear.

As for glass, the blowing of it convinceth, that the little darts of fire which pierce it every way, do naturally in the melting of it convert it into little round hollow bodies, which in their cooling must settle into parts of the like figure. Then for crystal and other transparent stones which are found in cold places; it cannot be otherwise, but that the nature of cold piercing into the main body, and contracting every little part in it self, this contraction must needs leave vacant pores between part and part. And that such transparent stones as are made by heat, have the like effect and property, may be judged out of what we see in bricks and tiles, which are left full of holes by the operation of the fire. And I have seen in bones that have lain a long time in the Sun, a multitude of sensible little pores close to one another, as if they had been formerly stuck all over with

10.

A confirmation of the former doctrine, out of the nature of bodies that refract light.

with subtile sharp needles as close as they could be thrust in by one another. The Chymical oyls and spirits which *Monsieur Des Cartes* speaketh of, are likely to be of the same composition; since that such use to be extracted by violent fires: for a violent fire is made by the conjunction of many raies together; and that must needs cause great pores in the body it worketh upon; and the sticking nature of these spirits, is capable of conserving them.

Out of all these observations, it followeth, that the bodies in which greatest refractions do happen, are compounded (as we have said) of great parts, and great pores. And therefore, by onely taking light to be such a body as we have described it to be, where we treated of the nature of it; it is evident, that the effect which we have exprest, must necessarily follow by way of reflexion, and that refraction is nothing else but a certain kind of reflexion.

Which last assertion, is likewise convinced out of this; that the same effects proceed from reflexion as from refraction: for by reflexion a thing may be seen greater than it is; in a different place from the true one where it is: colours may be made by reflexion, as also gloating light; and fire likewise, and peradventure all other effects which are caused by refraction, may as well as these, be performed by reflexion. And therefore it is evident, they must be of the same nature; seeing that children are the resemblances of their parents.

CHAP. XIV.

Of the composition, qualities, and generation of mixed bodies.

I. **H**AVING now declared the virtues by which fire and earth work upon one another, and upon the rest of the elements; which is, by light, and by the motions we have discoursed of. Our task shall be in this chapter first to observe what will result out of such action of theirs: and next, to search into the waies and manner of compassing and performing it. Which latter we shall the more easily attain unto, when we first know the end that their operation levelleth at. In this pursuit we shall find that the effect of the elements combinations, by means of the motions that happen among them; is a long pedigree of compounded qualities and bodies: wherein the first combinations (like marriages) are the breeders of the next more composed substances: and they again are the parents of others in greater variety:

The connexion of this chapter with the rest, and the Authors intent in it.

variety : and so are multiplied without end ; for the further this work proceedeth, the more subjects it maketh for new business of the like kinde.

To descend in particular unto all these, is impossible. And to look farther than the general heads of them, were superfluous and troublesome in this discourse ; wherein I aim onely at shewing what sorts of things in common, may be done by bodies : that if hereafter we meet with things of another nature and strain, we may be sure they are not the off-spring of bodies and of quantity ; which is the main scope of what I have designed here. And to do this with confidence and certainty, requireth of necessity this leisurely and orderly proceeding that hitherto we have used, and shall continue to the end : for walking thus softly, we have alwaies one foot upon the ground ; so as the other may be sure of firm footing before it settle. Whereas, they that for more haste will leap over rugged passages and broken ground, when both their feet are in the air, cannot help themselves, but must light as chance throweth them.

To this purpose then we may consider, that the qualities of bodies in common are of three sorts : for they are belonging either to the constitution of a compounded body, or else to the operation of it ; and the operation of a body, is of two kinds, the one, upon other bodies, the other, upon sense. The last of these three sorts of qualities, shall be handled in a peculiar chapter by themselves. Those of the second sort, whereby they work upon other bodies, have been partly declared in the former chapters, and will be farther discoursed of in the rest of this first Treatise : so as that which remaineth for the present, is to fall upon the discourse of such qualities as concur to the constitution of bodies ; with an aim to discover, whether (or no) they may be effected by the several mixtures of rarity and density, in such sort as is already declared. To which end, we are to consider in what manner these two primary differences of bodies may be joyned together : and what effects such conjunction will produce.

As for their conjunction : to deliver the nature of it entirely, That there is a
we must begin from the very root of it, and consider how the least size of
Universe being finite (which Mr. White hath demonstrated in bodies, and
the second knot of his first Dialogue) there cannot be an infinite that this least
number of bodies in it ; for Geometricians shew us how the least size is found
in fire.

quantity that is, may be repeated so often as would exceed any the greatest determinate quantity whatsoever. Out of which it followeth, that although all the other bodies of the world were no bigger than the least quantity that can be designed; yet they being infinite in number, would be greater than the whole universe that containeth them. And therefore, of necessity there must be some least body, or rather, some least size of bodies: which in compounded bodies is not to be expected: for, their least parts being compounded, must needs include compounding parts less than themselves. We must then look for this least size of bodies in the Elements; which of all bodies are the simplest. And among them, we must pitch upon that, wherein is greatest divisibility, and which consequently is divided into least parts; that is, fire: so as we may conclude that among all the bodies in the world, that which of its own nature hath an aptitude to be least, must be fire.

3.
The first conjunction of parts is in bodies of least size; and it is made by the force of Quantity.

Now, the least body of fire, be it never so little, is yet divisible into less. What is it then that maketh it be one? To determine this, we must resort unto the nature of *Quantity*: whose formal notion and essence is, *To be divisible*; which signifieth, that many may be made of it; but that of which many may be made, is not yet many, out of this very reason, that many may be made of it. But, what is not many, is one. Therefore what hath quantity, is, by meer having quantity, actually and formally as well one, as it hath the possibility of being made many. And consequently, the least body of fire, by having quantity, hath those parts which might be many, actually one. And this is the first conjunction of parts that is to be considered in the composition of bodies: which though it be not an actual joyning of actual parts; yet it is a formal conjunction of what may be many.

4.
The second sort of conjunction is compactedness in simple Elements, and it proceedeth from density.

In the next place we may consider, how seeing the least bodies that are, be of fire; it must needs follow, that the least parts of the other Elements must be bigger than they. And consequently, the possible parts of those least parts of the other Elements must have something to conserve them together, more than is found in fire. And this, because Elements are purely distinguished by rarity and density, is straight concluded to be *density*. And thus we have found; that as quantity is the cause of the possible parts being one, so density is the cause of the like parts sticking together.

together : which appeareth in the very definition of it, for, *to be less divisible*, (which is the notion of density) speaketh a resistance to division, or a sticking together.

Now let us examine how two parts of different Elements are joyned together, to make a compound. In this conjunction we find both the effects we have already touched : for, two such parts must make one ; and moreover, they must have some resistance to divisibility. The first of these effects we have already assigned unto the nature of quantity. And it being the formal effect of quantity ; it cannot (wheresoever it is found) have any other formal cause than quantity : and therefore either the two little parts of different Elements, do not become one body : or if they do, we must agree that it is by the nature of quantity which worketh as much in heterogeneal parts, as it doth in homogeneal ones. And it must needs do so : because Rarity and Density (which are the proper differences of Quantity) cannot change the common nature of Quantity, that is their Genus : which by being so to them, must be univocally in them both. And this effect cometh precisely from the pure notion of the Genus : and consequently, must be seen as well in two parts of different natures, as in two parts of the same nature : but in parts of the same nature, which once were two, and afterwards become one ; there can be no other reason why they are one, than the very same : for which those parts that were never separated (but that may be separated) are likewise one : and this most evidently is the nature of quantity.

Experience seemeth to confirm thus much ; when pouring water out of a basin, some of it will remain sticking to the sides of the metal : for if the quantity of the basin, and of the water, had not been one and the same by its own nature ; the water (considering the pliability of its parts) would certainly have comminall away, and have glided from the unevenness of the basin, by the attractive unity of its whole, and would have preserved the unity of its quantity within it self, rather than by sticking to the basin, have suffered division in its own quantity ; which we are sure was one, while the water was altogether in the basin : but that, both the basin and the water making but one quantity ; and a division being unavoidable in that one quantity ; it was indifferent, in regard of the quantity considered singly

by itself, where this division should be made, whether in the parts of the basin, or in the parts of the water: and then, the other circumstances determined it in that part of the water which was nearest to the joyning of it with the basin.

The second effect (which was resistance to divisibility;) we assigned unto density. And of that same cause, must also depend the like effect in this case of the sticking together of the two parts of different Elements, when they are joyned to one another: for if the two parts, whereof one is dense, the other is rare, do not exceed the quantity of some other part of one homogeneal rare Element, for the dividing whereof, such a determinate force, and no less can suffice; then, seeing that the whole composed of these two parts is not so divisible as the whole consisting of that one part, the assigned force will not be able to divide them. Wherefore it is plain, that if the rare part had been joyned to another rare part in stead of the dense one it is joyned unto, it had been more easily dividable from that than now it is from the dense part. And by consequence it sticketh more closely to the dense part, than it would to another of its own nature.

6.
The reason
why liquid bo-
dies do easily
joyn together;
and dry ones
difficulty.

Out of what we have said, a step is made us to understand why soft and liquid bodies do easily joyn and incorporate into one continued body; but hard and dry bodies so difficultly, as by experience we find to be true. Water with water, or wine either with other wine or with water, so uniteth, that it is very hard to part them: but sand or stones cannot be made to stick together without very great force and industry. The reasons whereof, must necessarily depend of what we have said above, To wit, that two bodies cannot touch one another, without becoming one: and, that if two bodies of one degree of density do touch, they must stick together according to the force of that degree of density. Out of which two, is manifestly inferred, that if two hard things should come to touch, they must needs be more difficultly separated than two liquid things. And consequently, they cannot come to touch, without as much difficulty, as that whereby they are made one.

7.
That no two
hard bodies
can touch one
another im-
mediately.

But to deduce this more particularly; let us consider, that all the little surfaces, by which one hard body may be conceived to touch another (as for example, when a stone lieth upon a stone) must of necessity be either plain, or concave, or convex. Now

if.

if a plain superficies should be supposed to touch another plain one coming perpendicularly to it; it must of necessity be granted to touch it as soon in the middle as on the sides. Wherefore if there were any air (as of necessity there must be) betwixt the two surfaces before they touched; it will follow that the air which was in the middle must have fled quite out from between the two surfaces, as soon as any part of the surfaces do touch; that is, as soon as the air which was between the utmost edges of the surfaces did fly out; and by consequence it must have moved in an instant.

But if a plain surface be said to touch a convex surface; it toucheth it onely by a line, (as Mathematicians demonstrate) or onely by a point. But, to touch by a line or a point, is in truth, not to touch by the form or notion of Quantity (which requireth divisibility in all that belongeth unto it;) and by consequence among bodies it is not to touch; and so, one such surface doth not touch the other.

Now for a plain surface to touch a concave, every man seeth it impossible. Likewise for two convex surfaces to touch one another, they must be allowed to touch either in a line or in a point, which we have shewed not to be a physical touching. And if a convex surface should be said to touch a concave, they must touch all at once as we said of plain surfaces; and therefore the same impossibility will arise therein: so that it is evident, that no two surfaces moving perpendicularly towards one another, can come to touch one another, if neither of them yieldeth and changeth its hew.

Now then, if it be supposed that they come slidingly one over another in the same line; whereby, first the very tips of the edges come to touch one another; and still as you shoove the uppermost on forwards, and that it slideth over more of the nether surface, it gaineth to touch more of it. I say that neither in this case do they touch immediately one another: for as soon as the two first parts should meet, if they did touch, and that there were no air between them; they must presently become one quantity or body as we have declared; and must stick firmly together, according to their degree of density; and consequently could not be moved on without still breaking asunder at every impulse, as much of the massie body, as were already made one by their touching.

And if you should say they did not become one; and yet allow them to touch immediately one another without having any air or fluid body between them; then if you suppose them to move onwards upon these terms; they would be changed locally, without any intrinsecal change: which in the book *De Mundo* (as we have formerly alleged) is demonstrated to be impossible.

There remaineth onely a third way for two hard surfaces to come together; which is, that first they should rest sloping one upon another, and make an angle where they meet (as two lines, that cut one another, do in their point of their intersection) and so contain as it were a wedge of air between them, which wedge they should lessen by little and little, through their moving towards one another at their most distant edges (whiles the touching edges are like immoveable centers that the others turn upon) till at length they shut out all the air, and close together, like the two legs of a compass.

But neither is it possible that this way they should touch, for after their first touch by one line (which neither is in effect a touching, as we have shewed) no other parts of them can touch, though still they approach nearer and nearer, until their whole surfaces do intirely touch at once: and therefore the air must in this case leap out in an instant a greater space, than if the surfaces came perpendicularly to one another; for here it must fly from one extremity to the other: whereas, in the former case, it was to go but from the middle to each side.

And thus it is evident that no two bodies can arrive to touch one another, unless one of them at the least have a superficies pleyable to the superficies of the other; that is, unless one of them be soft, which is to be liquid in some degree. Seeing then, that by touching, bodies do become one; and that liquidity is the cause and means whereby bodies arrive to touch; we may boldly conclude, that two liquid bodies do most easily and readily become one; and next to two such, a liquid and a hard body, are soonest united: but two hard ones most difficultly.

8.
How mixed
bodies are framed in general.

To proceed then with our reflections upon the composition of bodies, and upon what resulteth out of the joyning and mixture of their first differences Rarity and Density; we see, how if a liquid substance happeneth to touch a dry body it sticketh easily there-

thereunto. Then consider, that there may be so small a quantity of such a liquid body, as it may be almost impossible for any natural agent to divide it farther into any less parts; and suppose that such a liquid part is between two dry parts of a dense body, and sticking to them both, becometh in the nature of a glew to hold them together: will it not follow out of what we have said, that these two dense parts will be as hard to be severed from one another, as the small liquid part by which they stick together is to be divided? So that, when the viscuous ligaments which in a body do hold together the dense parts, are so small and subtile, as no force we can apply unto them can divide them, the adhesion of the parts must needs grow then inseparable. And therefore, we use to moisten dry bodies, to make them the more easily be divided; whereas those that are overmoist are of themselves ready to fall in pieces. And thus you see how in general, bodies are framed.

Out of which discourse, we may ballance the degrees of solidity in bodies, for all bodies being composed of humid and dry parts, we may conceive either kind of those parts, to be bigger or lesser, or to be more rare or more dense. Now if the dry parts of any body be extreme little and dense; and the moist parts that joyn the dry ones together, be very great and rare; then that body will be very easie to be dissolved. But if the moist parts which glew together such extreme little and dense dry parts, be either lesser in bulk, or not so rare; then the body composed of them will be in a stronger degree of consistence. And if the moist parts which serve for this effect, be in an excess of lightness and withall dense; then, the body they compose will be in the highest degree of consistence that nature can frame.

On the other side; if you glew together great dry parts which are moderately dense and great, by the admixion of humid parts that are of the least size in bulk, and dense withall; then the consistence will decrease from the height of it, by how much the parts are greater, and the density less. But if unto dry parts of the greatest size, and in the greatest remisseness of density, you add humid parts that are both very great and very rare, then the composed body will prove the most easily dissolvable of all that nature affordeth.

After this, casting our eyes a little farther towards the com-
10. The rule
K 4 position

9.

The cause of
the several de-
grees of solidi-
ty in mixed
bodies.

whereunto are
reduced all
the several
combinations
of Elements in
compounding
of mixed bo-
dies.

position of particular bodies; we shall find still greater mixtures, the farther we go; for as the first and simplest compounded bodies, are made of the four Elements; so, others are made of these; and again a third sort of them: and so onwards, according as by motion the parts of every one are broken in sunder, and mingled with others. Those of the first order, must be of various tempers according to the proportions of the Elements, whereof they are immediately made. As for example, such a proportion of fire to the other three Elements, will make one kind of simple body, and another proportion will make another kind: and so throughout, by various combinations and proportions among all the Elements.

In the effecting of which work, it will not be amiss to look a little upon nature, and observe how she mingleth and tempereth different bodies one with another, whereby she begetteth that great variety of creatures which we see in the world. But because the degrees of composition are infinite, according to the increase of number, we will contain our selves within the common notions of excess in the four primary components; for if we should descend once to specific any determinate proportions, we should endanger losing our selves in a wood of particular natures, which belong not to us at present to examine. Then taking the four Elements as materials to work upon: Let us first consider how they may be varied, that differing compositions may result out of their mixtures. I conceive that all the waies of varying the Elements in this regard, may be reduced to the several sizes of bigness, of the parts of each Element, that enter into the composition of any body, and to the number of those parts: for certainly no other can be imagined, unless it were variety of figure.

But that cannot be admitted to belong in any constant manner to those least particles whereof bodies are framed; as though determinate figures were in every degree of quantity due to the natures of elements, and therefore, the elements would conserve themselves in those figures, as well in their least atoms, as in massie bulk: for seeing how these little parts are shuffled together without any order; and that all liquids easily joyn, and take the figures which the dense ones give them; and that they again jostling one another, do crush themselves into new shapes,
which.

which their mixture with the liquid ones, maketh them yeeld the more easily unto: it is impossible that the elements should have any other natural figure in these their least parts, than such as chance giveth them. But that one part must be bigger than another is evident; for the nature of rarity and density giveth it: the first of them causing divisibility into little parts, and the latter hindering it.

Having then settled in what manner the elements may be varied in the composition of bodies; let us now begin our mixture. In which our ground to work upon must be earth and water; for onely these two are the basis of permanent bodies, that suffer our senses to take hold of them, and that submit themselves to trial: whereas if we should make the predominant element to be air or fire, and bring in the other two solid ones under their jurisdiction to make up the mixture, the compound resulting out of them would be either in continual consumption (as ordinary fire is) or else imperceptible to our eyes or touch, and therefore not a fit subject for us to discourse of, since the other two afford us enough to speculate upon. Peradventure our smell might take some cognisance of a body so composed, or the effect of it taken in by respiration, might in time shew it self upon our health: but it concerneth not us now to look so far; our designe requireth more maniable substances.

Of which let water be the first; and with it we will mingle the other three elements, in excess over one another by turns; but still all of them overwayed by a predominant quantity of water: and then let us see what kind of bodies will result out of such proportions. First, if earth prevail above fire and air, and arrive next in proportion to the water, a body of such a composition must needs prove hardly liquid, and not easie to let its parts run asunder, by reason of the great proportion of so dense a body as earth that holdeth it together. Yet some inclination it will have to fluidness, by reason the water is predominant over all; which also will make it be easily divisible, and give very little resistance to any hard thing that shall be applied to make way through it. In a word, this mixture maketh the constitution of mud, dirt, honey, butter, and such like things where the main parts are great ones, And such are the parts of earth and water in themselves.

I I.

Earth and water are the basis of all permanent mixed bodies.

I 2.

What kind of bodies those are, where water is the basis, and earth the predominant element over the other two.

Let

13.
Of those bodies, where water being the basis, air is the predominant Element.

Let the next proportion of excess in a watery compound, be of air, which when it prevaleth, it incorporateth it self chiefly with earth, for the other Elements would not so well retain it. Now, because its parts are subtile (by reason of the rarity it hath) and sticking, (because of its humidity) it driveth the earth and water likewise into lesser parts. The result of such a mixture is, that the parts of a body compounded by it are close, catching, flowing, slowly glibb, and generally it will burn, and be easily converted into flame.

Of this kind, are those which we call oylly or unctuous bodies, whose great parts are easily separated, (that is, they are easily divisible in bulk,) but the small ones very hardly. Next the smallness, and well-working of the parts, by means of the airs penetrating every dense one, and sticking close to every one of them, and consequently, joyning them without any unevenness; causeth that there can be no ruggedness in it; and therefore, it is glib: in like manner as we see plaster or starch become smooth when they are well wrought. Then, the humidity of it causeth it to be catching, and the shortness of every part, maketh that where it sticketh, it is not easily parted thence. Now the rarity of air next unto fire, admitteth it to be (of all the other Elements) most easily brought to the height of fire, by the operation of fire upon it. And therefore, oyles are the proper food of that Element. And accordingly we see, that if a drop of oyl be spilled upon a sheet of paper, and the paper be set on fire at a corner; as the fire cometh near the oyl, the oyl will disperse and spread it self upon the paper to a broader compass than it had; which is because the heat rarifieth it; and so, in oyl it self, the fire rarifying the air, maketh it penetrate the earthy parts adioyned unto it, more than it did; and so subtilizeth them, till they be reduced to such a height as they are within the power of fire to communicate his own nature unto them: and thus, he turneth them into fire, and carrieth them

14.
What kind of up in his flame.

But if fire be predominant over earth and air in a watry compound; it maketh the body so proportioned, to be subtile, rare, penetrative, hot in operation, light in weight, and subject to burn. Of this kind are all sorts of wines, and distilled spirits commonly called strong waters or Aquavites; in *Latine Aquæ ardentes.*

ardentes. These will lose their virtues meerly by remaining uncovered in the air; for fire doth not incorporate strongly with water; but, if it find means, raiseth it self in the air; as we see in the smoak of boyling water, which is nothing else but little bodies of fire, that entring into the water, do rarifie some parts of it; but have no inclination to stay there, and therefore as fast as they can get out, they fly away; but the humid parts of the water, which they have rarified (being of a sticking nature) do joyn themselves unto them, and ascend in the air as high as the fiery atoms have strength to carry them: which when it faileth them that smoke falleth down in a dew, and so becometh water again as it was. All which one may easily discern in a glass vessel of water set over the fire; in which one may observe the fire come in at the bottom, and presently swim up to the top like a little bubble, and immediately rise from thence in smok; and that will at last convert it self into drops and settle upon some solid substance thereabouts.

Of these fiery spirits, some are so subtile, as of themselves they will vanish, and leave no residue of a body behind them; and A chymists profess to make them so ethereal and volatil, that being poured out of a glass from some reasonable height, they shall never reach the ground: but that before they come thither they will be so rarified by that little motion, as they shall grow invisible like the air, and dispersing themselves all about in it, they will fill the chamber with the smell of that body which can no longer be seen.

The last excess in watery bodies, must be of water it self, which is, when so little a proportion of any of the other is mingled with it, as is hardly perceptible: out of this composition do arise all those several sorts of juices or liquors which we commonly call waters: which by their mixture with the other three Elements, have peculiar properties beyond simple Elemental water. The general quality whereof, we shall not need any further to express, because by what we have already said of water in common, they are sufficiently known.

15.

Of those bodies, where water is in excess, it alone being both the basis, and the predominant Element.

In our next survey, we will take earth for our ground to work upon, as hitherto we have done water: wch if in any body, it be in the utmost excess of it beyond all the other three; then rocks and stones will grow out of it; whose driness and hardness may assure

16.

Of those bodies, where Earth alone is the basis, and

also the predominant in excess over the other three Elements.

17.

Of those bodies where earth is the basis, and water the predominant element over the other two.

assure us, that earth swayeth in their composition, with the least allay that may be. Nor doth their lightness (in respect of some other earthy compositions) impeach this resolution; for that proceedeth from the greatness and multiplicity of pores, wherewith their driness causeth them to abound; and hindereth not, but that their real solid parts may be very heavy.

Now if we mingle a considerable proportion of water with earth, so as to exceed the fire and air, but still inferior to the earth; we shall produce metals; whose great weight with their ductility and malleability, plainly telleth us, that the smallest of waters gross parts, are the glew that holdeth the earthy dense ones together; such weight belonging to earth, and that easie changing of parts, being most proper to water. Quicksilver (that is the general matter whereof all the metals are immediately composed) giveth us evidence thereof; for fire worketh upon it with the same effect as upon water. And the calcination of most of the metals, proveth that fire can easily part and consume the glew by which they are closed and held together: which therefore must be rather of a watry than of an airy substance. Likewise the glibness of Mercury, and of melted metals, without catching or sticking to other substances, giveth us to understand, that this great temper of a moist element with earth is water, and not air; and that the watry parts are comprised, and as it were shut up within the earthy ones: for air catcheth and sticketh notably to all things it toucheth, and will not be imprisoned; the divisibility of it being exceeding great, though in never so short parts.

18.

Of those bodies, where earth being the basis, air is the predominant.

Now if air mingleth it self with earth and be predominant over water and fire, it maketh such an oily and fat soil, as husbandmen account their best mould; which receiving a betterment from the sun and temperate heat, assureth us of the course of the air: for wheresoever such heat is, air cannot fail of accompanying it, or of being effected in it; and the richest of such earth (as pot-earth and marl) will with much fire grow more compacted, and stick closer together than it did; as we see in baking them into pots or fine bricks. Whereas if water were the glew between the dense parts, fire would consume it, and crumble them asunder, as it doth in those bodies it calcineth. And excess of fire will bring them to vitrification; which still

con-

confirmeth that air aboundeth in them; for it is the nature of air to stick so close where once it is kneaded in, as it cannot be separated without extream difficulty. And to this purpose the viscous holding together of the parts of glass when it is melted, sheweth evidently that air aboundeth in vitrified bodies.

The last mixture we are to meddle with, is of fire with earth, in an overruling proportion over air and water. And this I conceive produceth those substances, which we may term coagulated juices, and which the Latines do call *succi concreti*: whose first origine seemeth to have been liquors, that have been afterwards dried by the force either of heat or of cold. Of this nature are all kind of sales, niters, sulphurs, and divers sorts of bitumens. All which easily bewray the relicks and effects of fire left in them, some more, some less, according to their degrees.

And thus we have in general deduced from their causes the complexions of those bodies, whereof the bulk of the world subjected to our use, consisteth; and which serve for the production and nourishment of living creatures, both animal and vegetable. Not so exactly (I confess) nor so particularly, as the matter in it self, or as a Treatise confined to that subject, would require: yet sufficiently for our intent. In the performance whereof, if more accurate searchers of nature shall find: that we have peradventure been mistaken in the minute delivering of some particular bodies complexion; their very correction (I dare boldly say) will justifie our principal scope: which is, to shew that all the great variety we see among bodies ariseth out of the commixtion of the first qualities, and of the Elements: for they will not be able to correct us upon any other grounds than those we have laid.

As may easily be perceived, if we cast a summary view upon the qualities of composed bodies. All which we shall finde to spring out of rarity and density, and to favour of their origine: for the most manifest qualities of bodies may be reduced to certain pairs opposite to one another. As namely some are liquid and flowing, others are consistent; some are soft, others hard; some are fatty, viscuous, and smooth, others lean, gritty, and rough; some gross, others subtile; some tough, others brittle: and the like. Of which, the liquid, the soft, the fat, and the viscuous, are so manifestly derived from rarity, that we need not take

19.

Of those bodies where earth being the basis fire is the predominant.

20.

All the second qualities of mixed bodies, arise from several combinations of the first qualities: and are at last resolved into several degrees of rarity and density.

take any further pains to trace out their origine : and the like is of their contraries from the contrary cause ; to wit, of those bodies that are consistent, hard, lean, and gritty, all which do evidently spring from density. As for smoothness, we have already shewed how that proceedeth from an aicy or oily nature ; and by consequence, from a certain degree of rarity. And therefore roughness (the contrary of it) must proceed from a proportionable degree of density. Toughness is also a kinde of ductility, which we have reduced to watriness, that is, to another degree of rarity ; and consequently brittleness must arise from the contrary degree of density. Lastly, grossness and subtilness do consist in a difficulty or facility to be divided into small parts, which appeareth to be nothing else but a certain determination of rarity and density. And thus we see how the several complexions of bodies are reduced to the four elements that compound them : and the qualities of those bodies, to the two primary differences of quantative things by which the elements are diversified.

21. And out of this discourse it will be evident, that these complexions and qualities, though in diverse degrees, must of necessity be found wheresoever there is any variation in bodies : for seeing there can be no variation in bodies, but by rarity and density ; and that the pure degrees of rarity and density do make heat, cold, moisture, and driness, and (in a word) the four elements ; it is evident, that wheresoever there is variety of bodies, there must be the four Elements ; though peradventure far unlike these mixed bodies which we call elements. And again, because these elements cannot consist without motion ; and because by motion they do of necessity produce mixed bodies, and forge out those qualities which we come from explicating ; it must by like necessity follow, that wheresoever there is any variety of active and passive bodies, there mixed bodies likewise must reside of the same kinds, and be indued with qualities of the like natures, as those we have treated of ; though peradventure such as are in other places of the world remote from us, may be in a degree far different from ours.

Since then it cannot be denied, but that there must be notable variety of active and passive bodies wheresoever there is light : neither can it be denied but that in all those great bodies from which

That in the planets and stars there is a like variety of mixed bodies caused by light as here upon earth.

which light is reflected unto us, there must be a like variety of complexions and of qualities, and of bodies tempered by them. as we finde here in the orb we live in. Which systeme, how different it is from that which *Aristotle* and the most of the School have delivered us, as well in the evidencies of the proofs for its being so; as in the position and model of it; I leave unto the prudent readers to consider and judge.

Out of what hath been already said, it is not hard to discover in what manner the composition of bodies is made. In effecting of which, the main hinge whereon that motion dependeth is fire or heat: as it likewise is in all other motions whatsoever. Now because the composition of a mixed body, proceedeth from the action of one simple body or element upon the others; it will not be amiss to declare by some example how this work passeth: for that purpose let us examine how fire or heat worketh upon his fellows.

22.

In what manner the elements do work upon one another, in the composition of mixed bodies: and in particular fire which is the most active.

By what we have formerly delivered, it is clear that fire streaming out from its center, and diffusing it self abroad, so as to fill the circumference of a larger circle, it must needs follow, that the beams of it are most condensed and compacted together neer the center; and the farther they stream from the center, the more thin and rarified they must grow: yet this is with such moderation, as we cannot any where discern that one beam doth not touch another; and therefore the distances must be very small. Now let us suppose that fire happeneth to be in a viscous and tenacious body; and then consider what will happen in this case: of one side, the fire spreadeth it self abroad; on the other side, the parts of the tenacious body being moist (as we have formerly determined) their edges on all hands will stick fast to the dry beams of the fire that pass between them. Then they stretching wider and wider one from another, must needs draw with them the parts of that tenacious body which stick unto them; and stretch them into a greater wideness or largeness than they enjoyed before, from whence it follows, that (seeing there is no other body neer thereabouts but they two) either there must be a vacuity left, or else the tenacious body must hold and fill a greater space than it did before, and consequently be more rare.

Contrariwise, if any of the other elements be stronger than fire, the denser elements break off from their continued stream the little

little parts of fire which were gotten into their greater parts, and sticking on all sides about them, they do so enclose them that they have no more semblance of fire: and if afterwards by any accident there cometh a great compression, they force them to lose their natural rarity, and to become some other Element. Thus it fareth with fire, both in acting and in suffering. And the same course, we have in both these regards expressed of it, passeth likewise in the rest of the Elements to the proportion of their contrarieties.

Hence it followeth, that when fire meeteth with humidity in any body, it divideth and subtiliseth it, and disperseth it gently, and in a kind of equal manner through the whole body it is in, (if the operation of it be a natural and a gentle one) and so driveth it into other parts, which at the same time it prepareth to receive it by subtilising likewise those parts. And thus moderate fire, maketh humor in very small parts to incorporate it self in an even or uniform manner with the dry parts it meeteth with: all: which being done, whether the heat doth afterwards continue, or that cold succeedeth in lieu of it, the effect must of necessity be, that the body thus composed, be bound up and fastened, more or less, according to the proportion of the matter it is made of, and of the Agents that work upon it, and of the time they employ about it. This is every day seen, in the ripening of fruits, and in other frequent works, as well of art as of nature, and is so obvious, and sensible to any reasonable observation, that it is needless to enlarge my self much upon this subject.

23.
A particular
declaration
touching the
generation of
metals.

Onely, it will not be amisse, for examples sake, to consider the progress of it in the composing or augmenting of metals, or of earths of divers sorts: first heat (as we have said) draweth humor out of all the bodies it worketh upon: then if the extracted humour be in quantity, and the steams of it do happen to come together in some hollow place, fit to assemble them into greater parts; they are condensed, and they fall down in a liquid and running body. These steams being thus corporified, the body resulting out of them, maketh it self in the earth a chanel to run in: and if there be any loose parts in the chanel, they mingle themselves with the running liquor: and though there be none such, yet in time the liquor it self looseth the chanel all about, and imbibeth into its own substance the

the parts it raiseth. And thus, all of them compacted together, do roll along till they tumble into some low place, out of which they cannot so easily get to wander farther. When they are thus settled, they do the more easily receive into them, and retain such heat as is every where to be met withall, because it is diffused more or less through the earth. This heat if it be sufficient digesteth it into a solid body: the temper of cold likewise concurring in its measure to this effect. And according to the variety of the substances whereof the first liquor was made, and which it afterwards drew along with it, the body that resulteth out of them is diversified. In confirmation of all which, they that deal in mines tell us they use to finde metals oftentimes mingled with stones; as also coagulated juices with both; and earth of divers natures with all three, and they with it, and one with another among themselves. And that sometimes they find the mines not yet consolidated and digested thoroughly into metal; when by their experience knowing after how many years they will be ripe, they shut them up again till then.

Now if the hollow place wherein the body staid (which at the first was liquid and rolling) be not at once filled by it, but it taketh up onely part of it, and the same liquor continueth afterwards to flow thither, then this body is augmented, and groweth bigger and bigger. And although the liquors should come at several times, yet they become not therefore two several bodies, but both liquors do grow into one body: for the wet parts of the adventitious liquor do mollifie the sides of the body already baked; and both of them being of a like temper and cogitation, they easily stick and grow together.

Out of this discourse it followeth evidently, that in all sorts of compounded bodies whatsoever, there must of necessity be actually comprised sundry parts of divers natures: for otherwise, they would be but so many pure degrees of rarity and density; that is, they would be but so many pure elements, and each of them have but one determinate virtue or operation.

CHAP. XV.

Of the dissolution of mixed bodies.

THus much for composition of bodies. Their dissolution is made three waies; either by fire, or by water, or by some
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1.
Why some bodies are brittle
out

and others
tough or apt
to withstand
outward vio-
lence, the first
instrument to
dissolve mi-
xed bodies.

outward violence. We will begin with examining how this last is done: to which end we may consider, that the unity of any body consisting in the connexion of its parts; it is evident that the force of motion if it be exercised upon them, must of necessity separate them, as we see in breaking, cutting, filing, drawing asunder, and the like.

All these motions, because they are done by gross bodies, do require great parts to work upon, and are easily discerned how they work: so that it is not difficult to find the reason why some hard bodies break easily, and others with much ado. The first of which are called brittle, the others tough. For if you mark it, all breaking requireth that bending should precede; which on the other side compresseth the parts of the bended body, and condenseth them into a lesser room than they possessed before; and on the other side stretcheth them out, and maketh them take up more place. This requireth some fluid or movable substance to be within the body, else it could not be done; for without such help the parts could not remove. Therefore such hard bodies as have most fluid parts in them, are most flexible, that is, are toughest. And those which have fewest, though they become thereby hardest to have impression made upon them, yet if the force be able to do it, they rather yield to break than to bend, and thence are called brittle.

Out of this we may infer, that some bodies may be so suddenly bent as that thereby they break asunder; whereas if they were leisurely and gently dealt withall, they would take what ply one desireth. And likewise that there is no body (be it never so brittle and hard) but that it will bend a little (and indeed more than one would expect) if it be wrought upon with time and dexterity; for there is none but containeth in it some liquid parts more or less; even glass and brick. Upon which occasion I remember, how once in a great storm of wind, I saw the high slender brick chimneys of the Kings house at St. James (one winter when the Court lay there) bend from the wind like boughs, and shake exceedingly and totter. And at other times I have seen some very high and pointy spire steeples do the like. And I have been assured the like of the whole pile of a high castle, standing in a gullet in the course of the wind (namely the castle of *Wardour*) by those who have often seen it shake notably in a fierce wind.

The.

The reason of all which may be deduced out of what we have said above: for seeing that the bending of a body maketh the spirits or humours that are within it to sally forth; it is clear that if the violence which forceth it be not so sudden, nor the motion it receiveth be not so quick, but that the moisture may loose gently out; the body will bend still more and more, as their absence giveth it leave. But if the motion that is wrought in it be too quick, then the spirits not having time allowed them to go leisurely and gently out, do force their prison, and break out with a violence, and so the body is snapped into two.

Here peradventure some remembring what we have said in another place; namely, that it is the shortness and littleness of the humid parts in a body which maketh it stick together; and that this shortness may be in so high a degree, as nothing can come between the parts they glew together to divide them; may ask, how a very dense body of such a strain, can be broken or divided? But the difficulty is not great, for seeing that the humid parts in whatsoever degree of shortness they be, must necessarily have still some latitude; it cannot be doubted but there may be some force assigned greater than their resistance can be. All the question is, how to apply it to work its effect upon so close a compacted body, in which peradventure the continuity of the humid parts that bind the others together, may be so small, as no other body whatsoever (no, not fire) can go between them, in such sort as to separate part from part. At the worst, it cannot be doubted but that the force may be so applied at the outside of that body, as to make the parts of it press and fight one against another, and at the length by multiplication of the force, constrain it to yield and suffer division. And this I conceive to be the condition of gold and of some precious stones: in which the elements are united by such little parts, as nothing but a civil war within themselves (stirred up by some subtile outward enemy, whereby they are made to tear their own bowels) could bring to pass their destruction.

But this way of dissolving such bodies, more properly belongs to the next way of working upon them by fire: yet the same is done when some exteriour violence pressing upon those parts it toucheth, maketh them cut a way betwix their next neighbors; & so continuing the force divide the whole body. As when the chisel

or even the hammer with beating, breaketh gold asunder : for it is neither the chisel, nor the hammer that doth that effect immediately ; but they make those parts they touch, cut the others that they are forced upon. In such sort as I remember happened to a gentleman that stood by me (in a sea-fight I was in) with a coat of mail upon his body, when a bullet coming against a bonny part in him, made a great wound, and shattered all the bones neer where it struck : and yet the coat of mail was whole : it seemeth the little links of the mail yielding to the bullets force made their way into the flesh and to the bone.

3. But now it is time to come to the other two instruments of The several effects of fire, the second and chiefest instrument to dissolve all compounded bodies. separation of bodies, fire and water ; and to examine how they dissolve compounds. Of these two ; the way of working of fire, is the easiest and most apparent to be discerned. We may readily observe how it proceedeth, if we but set a piece of wood on fire ; in which it maketh little holes as if with bodkins it pierced it. So that the manner of its operation in common being plain, we need but reflex a little upon the several particular degrees of it. Some bodies it seemeth not to touch ; as clothes made of *Asbestus* ; which are onely purified by it. Others, it melteth, but consumeth not ; as gold. Others it turneth into powder, suddenly dissolving their body ; as lead, and such metals as are calcined by pure fire. Others again, it separateth into a greater number of differing parts ; as into spirits, waters, oyls, salts, earth and glass : of which rank are all vegetables. And lastly, others it converteth into pure fire ; as strong waters, or *Aqua vitæ* (called *aquæ ardentes*) and some pure oyls : for the smoke that is made by their setting on fire, and peradventure their sale is so little as is scarce discernable. These are in sum the divisions which fire maketh upon bodies, according to the nature of them, and to the due application of it unto them : for by the help and mediation of other things, it may peradventure work other effects

4. The reason why some bodies are not dissolved by fire.

Now to examine a little in particular, how the same fire, in differing subjects, produceth such different effects : *Limus ut hic durefcit, & hæc ut cera liquefcit, Uno eodẽmque igni ;* ——— We will consider the nature of every one of the subjects apart by it self. First, for the *Asbestus* : it is clear, that it is of a very dry substance ; so that to look upon it, when it is broken into very little pieces, they seem to be little bundles of short hairs, the

the liquidity within, being so little as it affordeth the parts neither length nor breadth : and therefore, fire meeteth with little there that it can dilate. But what it cannot dilate, it cannot separate ; nor carry away any thing of it, but what is accidentally adherent unto the outides of it. And so it seemeth onely to pass through the pores, and to cleanse the little thrids of it : but bringeth no detriment at all to the substance of it. In this I speak onely of an ordinary fire : for I doubt not but such a one is might be, as would perfectly calcine it.

The next body we spoke of is gold. This aboundeth so much in liquidity, that it sticketh to the fire, if duly applyed : but its humidity is so well united to its earthy parts, and is so perfectly incorporated with them, as it cannot carry away one, without likewise carrying away both : but both, are too heavy a weight for the little agile parts of fire to remove. Thus, it is able to make gold swell ; as we see in melting it : in which, the gold receiveth the fire into its bowels, and retaineth it a long time with it : but at its departure, it permitteth the fire to carry nothing away upon its wings : as is apparent, by the golds no whit decay of weight, after never so long fusion. And therefore, to have fire make any separation in gold, requireth the assistance of some other moist body, that on the one side may stick closely to the gold, when the fire driveth it into it, and on the other side may be capable of dilatation, by the action of the fire upon it. As in some sort we see in strong waters made of salts, which are a proper subject for the fire to dilate, who, by the assistance of fire, mingling themselves closely with little parts of gold, do pull them away from their whole substance, and do force them to bear them company in their journey upwards, in which, multitudes of little parts of fire, do concur to press them on and hasten them : and so, the weight of gold being at length overcome by these two powerfull Agents (whereof one supplieth, what the other wanteth) the whole substance of the metal, is in little atoms diffused through the whole body of the water. But this is not truly a dissolution or a separation of the substantial parts of gold, one from another : it is onely a corrosion, which bringeth it into a subtile powder, (when the water & salts are separated from it) much like what filing (though far smaller) or grinding of leaf gold upon a porphyre stone, may reduce it into : for neither the

5.

The reason why fire melteth gold, but cannot consume it.

parts of the water, nor of the fire that make themselves a way into the body of the gold, are small and subtile enough to get between the parts that compose the essence of it: and therefore all they can attain unto, is to divide it onely in his quantity or bulk, not in the composition of its nature.

Yet I intend not to deny but that this is possible to be arrived unto, either by pure fire dily applyed, or by some other assistance; as peradventure by some kind of Mercury; which being of a nearer cognation unto metals than any other liquor is, may happily have a more powerfull ingression into gold, than any other body whatsoever; and being withall very subject to rarefaction, it may (after it is entered) so perfectly penetrate the gold, as it may separate every least part of it, and so reduce it into an absolute calx. But in this place I explicate no more than what ordinarily passeth, leaving the mysteries of this art to those who profess it.

6. To go on then with what we have in hand: Lead hath abundance of water overmingled with its earth, as appeareth by its why lead is easily consumed and calcined by fire. And therefore the liquid parts of lead, are easily separated from its dry and earthy ones: and when it is melted the very shaking of it, causeth the gross parts to descend, and many liquid ones to fly away with the fire; so that suddenly it is thus converted into powder. But this powder is gross in respect of other metals; unless this operation be often reiterated, or the fire more powerfully applyed, than what is just enough to bring the body of the lead into powder.

7. The next consideration of bodies that fire worketh upon, is of such as it divideth into spirits, salts, oyles, waters, or phlegms, and earth. Now these are not pure and simple parts of the dissolved body, but new compounded bodies made of the first by the operation of heat. As smoke is not pure water, but water and fire together: and therefore becometh not water but by cooling, that is, by the fire flying away from it. So likewise those spirits, salts, oyles, and the rest; are but degrees of things which fire maketh of diverse parts of the dissolved body, by separating them one from another, and incorporating it self with them. And so they are all of them compounded of the four elements, and are farther resolvable into them. Yet

Yet I intend not to say that there are not originally in the body before its dissolution, some loose parts which have the properties of these bodies that are made by the fire in the dissolving of it: for seeing that nature worketh by the like instruments as art useth, she must needs in her accesses and defects produce like bodies to what art doth in dissolution; which operation of artis but a kind of excess in the progress of nature: but my meaning is, that in such dissolution there are more of these parts made by the working of fire, than were in the body before.

Now because this is the natural and most ordinary dissolution of things; let us see in particular how it is done: suppose then that fire were in a convenient manner applyed to a body that hath all sorts of parts in it; and our own discourse will tell us, that the first effect it worketh will be, that as the subtile parts of fire do divide and pass through that body, they will adhere to the most subtile parts in it; which being most agile and least bound and incorporated to the bowels of the body, and lying (as it were) loosely scattered in it, the fire will carry them away with it. These will be the first that are separated from the main body; which being retained in a fit receiver, will by the coldness of the circumdant air grow outwardly cool themselves, and become first a dew upon the sides of the glasse, and then still as they grow cooler, condense more and more; till at the length they fall down congealed into a palpable liquour; which is composed (as you see) of the hottest parts of the body, mingled with the fire that carried them out: and therefore this liquour is very inflammable, and easily turned into actual fire, as you see all spirits and *Aque ardentes* of vegetables are.

The hot and loose parts being extracted, and the fire continuing and increasing, those that will follow next are such as though they be not of themselves loose, yet are easiest to be made so; and are therefore most separable. These must be humid, and those little dry parts which are incorporated with the overflowing humid ones in them (for no parts that we can arrive unto are of one pure simple nature; but all are mixed and composed of the four elements in some proportion) must be held together with such gross glew as the fire may easily penetrate and separate them. And then the humid parts divided into little atoms do stick to the lesser ones of the fire: which by their multitude

of number and velocity of motion, supplying what they want of them in bulk; do carry them away with them. And thus these phlegmatick parts flie up with the fire, and are afterwards congealed into an insipid water: which if it have any savour, is because the first ardent spirits are not totally separated from it, but some few of them remain in it, and give some little life to the whole body of that otherwise flat liquor.

Now those parts which the fire separateth next from the remaining body, after the fiery and watry ones are carried away, must be such as it can work upon: and therefore must abound in humidity. But since they stir not till the watry ones are gone, it is evident that they are composed of many dry parts strongly incorporated, and very subtilly mixed with the moist ones; and that both of them are exceeding small, and are so closely and finely knit together, that the fire hath much ado to get between them, and cut the thrids that tie them together: and therefore they require a very great force of fire to carry them up. Now the composition of these sheweth them to be aerial: and (together with the fire that is mingled with them) they congeal into that consistence which we call oyl.

Lastly, it cannot be otherwise but that the fire, in all this while of continual application to the body it thus anatomiseth, hath hardened, and as it were rosted some parts into such greatness and driness as they will not flie, nor can be carried up with any moderate heat. But great quantity of fire being mingled with the subtiler parts of his baked earth maketh them very pungent and acrimonious in taste: so that they are of the nature of ordinary salt, and are so called; and by the help of water may easily be separated from the more gross parts, which then remain a dead and useles earth.

By this discourse it is apparent, that fire hath been the instrument which hath wrought all these parts of an entire body into the forms they are in; for whiles it carried away the fiery parts, it swelled the watry ones; and whiles it lifted up them it, digested the aerial parts; and whiles it drove up the oyls, it baked the earth and salt. Again, all these retaining for the most part, the proper nature of the substance from whence they are extracted; it is evident that the substance is not dissolved; (for so the nature of the whole would be dissolved & quite destroyed & extinguished in

in every part) but that onely some parts containing the whole substance, or rather the nature of the whole substance in them, are separated from other parts that have likewise the same nature in them.

The third instrument for the separation and dissolution of bodies is water, whose proper matter to work upon is salt. And it serveth to supply what the fire could not perform, which is the separation of the salt from the earth in calcined bodies. All the other parts fire was able to sever, but in these he hath so baked the little humidity he hath left in them with their much earth, as he cannot divide them any farther. And so though he incorporateth himself with them, yet he can carry nothing away with him. If then pure water be put upon that chalk, the subtilest dry parts of it do easily joyn to the supervenient moisture, and sticking close to it do draw it down to them: but because they are the lighter, it happeneth to them as when a man in a boat pulleth the land to him; that cometh not to him, but he removeth himself and his boat to it: so these ascend in the water as they dissolve. And the water more and more penetrating them, and by addition of its parts making the humidity which gleweth their earthy parts together greater and greater, doth make a wider and wider separation between those little earthy parts; and so imbueeth the whole body of the water with them, into which they are dispersed in little atoms. Those that are of biggest bulk remain lowest in the water. And in the same measure as their quantities dissolve into less and less, they ascend higher and higher in the water; till at the length the water is fully replenished with them, and they are diffused through the whole body of it: whiles the more grosse and heavy earthy parts (having nothing in them to make a present combination between them and the water) do fall down to the bottom, and settle under the water in dust.

In which because earth alone doth predominate in a very great excess, we can expect no other virtue to be in it, but that which is proper to meer earth; to wit, driness and weight. Which ordinary Alchymists look not after: and therefore call it *terra dumnata*: but others find a fixing quality in it, by which they perform very admirable operations. Now if you pour the impregnated water from the *terra damnata*, and then evaporate

8.

How water
the third in-
strument to
dissolve bo-
dies, dissolveth
calx into salt,
and so into
Terra damnata.

porate it, you will find a pure white substance remaining: Which by its bulk sheweth it self to be very easily, and by its pricking, and corrosive tast, will inform you much fire is in it, and by its easie dissolution in a moist place, that water had a great share in the production of it. And thus the salts of bodies are made and extracted.

.6
How water mingled with salt, becometh a most powerful Agent to dissolve other bodies.

Now as water doth dissolve salt, so by the incorporation and virtue of that corrosive substance it doth more than salt it self can do: for having gotten acrimony, and more weight by the mixture and dissolution of salt in it, it maketh it self a way into solid bodies, even into metals; as we see in brass and iron; which are easily rusted by salts dissolving upon them. And according as the salts are stronger, so this corrosive virtue encreaseth in them, even so much, as neither silver nor gold are free from their eating quality. But they, as well as the rest, are divided into most small parts, and are made to swim in water in such sort as we have explicated above, and whereof every ordinary Alchymist teacheth the practise.

But this is not all; salts do help as well to melt hard bodies and metals, as to corrode them: for some fusible salts flowing upon them by the heat of the fire, and others dissolved by the steam of the metal that incorporateth with them; as soon as they are in flux, they mingle with the natural juice of the metal, and penetrate them deeper, than without them the fire could do, and swell them and make them fit to run.

10.
How putrefaction is caused.

These are the principals wayes of the two last instruments in dissolving of bodies; taking each of them by it self. But there remaineth one more of very great importance, as well in the works of nature as of art; in which, both the former are joyned and do concur: and that is putrefaction. Whose way of working is by gentle heat and moisture to wet and pierce the body it worketh upon; whereby, it is made to swell: and the hot parts of it, being loosened, they are at length drunk up and drowned in the moist ones (from whence, by fire they are easily separated, as we have already declared;) and those moist parts afterwards leaving it, the substance remaineth dry, and falleth in pieces for want of the glew that held it together.

CHAP. XVI.

An explication of certain Maxims touching the operations and qualities of bodies: and whether the Elements be found pure in any part of the world.

OUt of what we have determined, concerning the natural actions of bodies, in their making and destroying one another, it is easie to understand the right meaning of some terms, and the true reason of some maxims much used in the schools. As first; when Philosophers attribute unto all sorts of corporeal agents, a *sphere of Activity*. The sense of that manner of expression, in fire appeareth plainly, by what we have already declared of the nature and manner of operation of that Element.

I.

What is the sphere of activity in corporeal Agents.

And in like manner, if we consider how the force of cold consisteth in a compression of the body that is made cold, we may perceive, that if in the cooled body there be any subtile parts which can break forth from the rest, such compression will make them do so. Especially, if the compression be of little parts of the compressed body within themselves, as well as of the outward bulk of the whole body round about: for at first the compression of such causeth in the body, where they are, little holes or pores in the places they are compressed and driven from; which pores they filled up when they were dilated at their own natural liberty. But being thus forcibly shrunk up into less room, afterwards, they squeeze again out of their croud all such very loose and subtile parts (residing till then with them) as can find their way out from among them. And these subtile parts that thus are delivered from the colds impression, get first into the pores that we have shewed were made by this compression. But they cannot long stay there; for the atoms of advenient cold that obsest the compressed body, do likewise with all their force throng into these pores, and soon drive out the subtile guests they find there, because they are more in number, bigger in bulk, and more violent in their course than they. Who therefore must yield unto them the little chanelles and capacities they formerly took up. Out of which they are thrust with such an impetuosity, that they spin from them with a vehemence, as quick-

quicksilver doth through leather, when to purifie it, or to bring an Amalgame to a due consistence, it is strained through the sides of it.

Now these showers or streams of atoms issuing from the compressed body, are on all sides round about it at exceeding little distances; because the pores out of which they are driven, are so likewise. And consequently, there they remain round about besieging it, as though they would return to their original homes, as soon as the usurping strangers that were too powerfull for them, will give them leave. And according to the multitude of them, and to the force with which they are driven out; the compass they take up round about the compressed body, is greater or lesser. Which besieging atoms are not so soon carried away by any exterior and accidental cause, but they are supplied by new emanations succeeding them out of the said compressed body.

Now this which we have declared by the example of cold, compressing a particular body, hapneth in all bodies wheresoever they be in the world: for this being the unavoidable effect of heat and of cold, wheresoever they reside; (which are the active qualities, by whose means not onely fire and water and the other two Elements, but all other mixed bodies composed of the Elements, have their activity) and they being in all bodies whatsoever (as we have proved above) it followeth evidently, that there is not a body in the world, but hath about it self an orb of emanations of the same nature which that body is of. Within the compass of which orb, when any other body cometh that receiveth an immutation by the little atoms whereof that orb is composed, the advenient body seemeth to be affected and as it were replenished with the qualities of the body from whence they issue. Which is then said to work upon the body that imbibeth the emanations that flow from it. And because this orb (regularly speaking) is in the form of a sphere, the passive body is said to be within the sphere of the others activity.

2. Secondly, when Philosophers pronounce, that *No corpore al nature can operari in distans*; that is, that no body can work upon another remote from it, without working first upon the body that lieth between them, which must continue and piece up the operation from the agent to the patient. The reason and truth of this maxim is in our Philosophy evident; for we having shewed

The reason
why no body
can work in
distance.

shewed that action among bodies is performed for the most part by the emission of little parts out of one body into another: as also, that such little parts cannot stream from the body that is their fountain, and settle upon a remote body, without passing through the interjacent bodies; which must furnish them, as it were, with chanel and pipes to convey them whither they are to go; It followeth manifestly, that the active emissaries of the working body, can never reach their distant mark, unless they be successively ferried over the *medium*, that lieth between them; in which, they must needs leave impressions of their having been there, and so work upon it in their passage, and leave in it their qualities and complexions; as a payment for their wastage over.

But peradventure some may contend, that these invisible scr-
jeants and workmen are too feeble and impotent to perform
those visible great effects we daily see. As when fire at the length
burneth a board that hath been a great while opposed to it,
though it touch not the body of the fire; or when a loadstone
draweth unto it a great weight of iron that is distant from it.

3.

An objection
answered a-
gainst the
manner of ex-
plicating the
former axiom:

Unto whom we shal reply, that if he will not grant these
subtile emanations from the agent body, to be the immediate
workers of these effects; he must allot that efficacy unto the
whole corpulency of all the Agent working in bulk (for besides
the whole, and the parts, there is no third thing to be considered
in bodies; since they are constituted by quantity;) but the whole
cannot work otherwise than by local motion: which in this case
it cannot do, because by the supposition, it is determined to keep
its distance from the passive body, and not to move towards it.
Therefore, this is impossible; whereas the other can appear but
difficult at the worst, and therefore must be admitted, when no
better and more intelligible solution can be found.

But withall we must note, that it is not our intention to say,
but that it may in some circumstances hapen that some particular
action or effect may be wrought in a remote part or body, which
shall not be the same in the intermediate body that lieth between
the agent and the patient, and that conveyeth the agents work-
ing atoms to the others body. As for example, when tinder or
naphtha is by fire made to burn at a yard distance from it, when
the interjacent air is but warmed by that fire. Or when the sun,
by means of a burning-glass or of some other reflection, setteth
some

some bodies on fire, and yet onely enlighteneth the glass and the air that are in the way. The reason of which is manifest to be the divers dispositions of the different subjects in regard of the Agent: and therefore it is no wonder that divers effects should be produced according to those divers dispositions.

4. A third position among Philosophers is, that all bodies which work upon others, do likewise as the same time, wherein they work, suffer from those they work upon: and contrariwise that all bodies which suffer from others, do at the same time work back again upon them. For the better understanding whereof, let us consider that all action among bodies is either purely local motion, else local motion with certain particularities which give it a particular name. As when we express the local motion of little atoms of fire, or of earth, or water upon and into other bodies by the words of heating or cooling; and so of the like. Now if the action be pure local motion, and consequently the effect produced by that action be meerly change of place; we must call to mind how two dense bodies moving one against the other, do each of them bear before them some little quantity of a rarer body immediately joyned unto them: and consequently, these more rare bodies must be the first to feel the power of the dense bodies, and to receive impressions from their motions; each of them, by the opposite rare body, which like an huissier goeth before to make way for his following master that obligeth him to this service.

Now when these rare ushers have struggled a while like the first lightly-armed ranks of two armies in the interjacent field between their main battails, that follow them close at the heels, they must at the length yield, when they are overborn by a greater weight than they can sustain; and then they recoil back, as it were to save themselves by getting in among the files of dense bodies that drove them on; which not opening to admit them, and yet they still flying violently from the mastering force that pursueth them; they press so hard upon what at the first pressed them on, as notwithstanding their density and strength they force them to retire back: for unless they do so, they are not of the number of those that work upon one another.

And this retiring, is either on both sides, or but of one side; If both, then it is evident how each of them is an Agent, and each of

of them a sufferer; each of them overcoming his opposite in such sort, as himself likewise receiveth blows and loss. But if onely one of the dense bodies be so shocked as to recoil back, then that onely suffereth in its body, and the other suffereth onely in its virtue; that is, in the air or other rare body it sendeth before it; which is driveth with such a violence, that it mastereth and quellereth the opposition of the other body, before it can reach to thake the dense body, before which it runneth. Yet that rare body must be pressed and broken into, in some measure, by the incounter of the other (which though never so weak, yet maketh some resistance) but much more when it cometh to grapple with the dense body it self: and so between them, it is wounded and infeeble, like those souldiers that first enter a breach in a town, from whence when they have driven the enemy, they pursue him to the cittadel, and force him from thence too; and so how maimed soever they prove, they make a free and easie way without resistance for the whole body of their army to follow them, and take quiet possission of that which did cost them so much to win.

And thus we see how it may happen that one of these moving bodies doth not suffer so much as to be staid in its journey; much less, to be driven back. And yet the other body at the same time work in some measure upon it, by working upon what is next to it; which recoiling against it must needs make some impression upon it, since there can be no opposition but must have some effect. Now this impression or effect, though it be not preceptible by causing a contrary motion, yet it must needs infeeble the virtue of the conquering Agent, and deaden the celerity of its motion. And thus it is evident, that in all pure local motions of corporeal Agents, every one of them must in some proportion suffer in acting, and in suffering must act.

And what we have said of this kind of action, may easily be applied to the other where the effect of local motion is designed by a particular name, as it is in the examples we gave of heating and cooling. And in that, the proceeding will appear to be the very same as in this; for if fire doth heat water, the water reacteth again, either upon the fire and cooleth it, if it be immediate unto it; or else upon the interjacent air, if it be at a distance from the fire. And so the air is in some measure cooled, by the cold atoms that issue from the water, whose compass or sphear

5.
The former doctrine applied to other local motions designed by particular names. And that Suisseths argument is of no force against this way of doctrine.

of

of activity being lesser than the fires, they cannot cool so far off, as the others can heat : but where they do arrive, they give their proportion of cold, in the very midst of the others army of fiery atoms, notwithstanding their multitude and violence.

According to which doctrine, our countryman *Suiffeth* his argument, that in the schools is held insoluble, hath not so much as any semblance of the least difficulty: for it is evident that such atoms of fire and of water as we determine heat and cold to be, may pass and croud by one another into the subjects they are sent unto by divers little streams without hindering one another (as we have declared of air and light) and each of them be received in their own nature and temper by the same subject; though sense can judge onely according to which of them is predominant, and according to the proportion of its superiority.

Upon which occasion we cannot chuse but note, how the doctrine of qualities is not onely unable to give account of the ordinary and plain effects of nature; but also useth to end in clear impossibilities and contradictions if it be driven far: as this argument of *Suiffeth* sheweth, and many others of the like nature.

6. A fourth position among Philosophers is, that some notions do admit the denominations of Intension and Remission, but that others do not. The reason of which we shall clearly see, if we but consider how these terms of *intension and remission*, do but express *more or less* of the thing that is said to be intended or remitted: for the nature of more and less doth imply a latitude and divisibility; and therefore cannot agree with the nature of such things as consist in an indivisible being. As for example, to be a *whole* or to be an *equal*, cannot be sometimes more, sometimes less; for they consist in such a rigorous indivisible being, that if the least part imaginable be wanting, it is no longer a *whole*, and if there be the least excess between two things, they are no longer equal, but are in some other proportion than of equality in regard of one another.

Why some notions do admit of intension and remission; and others do not.

And hence it is that *Aristotle* teacheth us that *substance* and the species of *Quantity*, do not admit of intension and remission; but that *Quality* doth. For first in *substance*, we know that the signification of this word is, that which maketh a thing be what it is, as is evident by our giving it for an answer to the question what a thing is. And therefore, if there were any divisibility in

in substance, it would be in *what* the thing is; and consequently, every division following that divisibility, would make the thing another *what*, that is another thing. And so the substance that is pretended to be changed by intension or remission, would not be divided, as is supposed, but would cease to be, and another substance would succeed in the room of it. Whereby you see that every mutation in substance, maketh a new thing: and that more and less in quiddity cannot be pronounced of the same thing.

Likewise in quantity, it is clear that its Specieses do consist in an indivisible: for as in numbers, ten lions (for example) or ten Elephants are no more in regard of multitude than ten flees or ten motes in the sun; and if you add or take any thing from ten, it is no more ten, but some other number: so likewise in continued extension, a span, an ell, an ounce, or any other measure whatsoever, ceaseth to be a span and the rest, if you add to it or diminish from it the least quantity imaginable. And peradventure, the same is also of figures, as of a sphear, a cube, a circle, a square, &c. though they be in the rank of qualities.

But if we consider such qualities as heat, cold, moisture, driness, softness, hardness, weight, lightness, and the like; we shall find that they may be in any body sometimes more, sometimes less, (according as the excess of any Element or mixture is greater in it, at one time than at another) and yet the body in which these qualities are intended or remitted, remain still with the same denomination. As when durt continueth still soft, though sometimes it be less soft, other whiles softer; and wax remaineth figurable, whether it be melted or congealed; and wood is still hot, though it lose or gain some degree of heat.

But such intension in any subject whatsoever hath its determinate limits that it cannot pass; for when more of that quality that we say is intended (that is, more of the atoms of the active body) is brought into the body that suffereth the intension, than its complexion can brook; it resigneth its nature to their violence, and becometh a new thing; such an one as they are pleased to make it. As when wood, with extremity of heating (that is, with bringing into it so many atoms of fire, that the fire is stronger in it than its own nature) is converted into fire, smoke, water, and ashes; and nothing remaineth of the nature of wood.

But before we end this chapter, we may remember how in the
M close 7. That in every

part of our habitable world; all the four Elements, are found pure in small atoms; but not in any great bulk. of the fourth we remitted a question concerning the existence of the Elements; (that is, whether in any places of the world there were any pure Elements, either in bulk or in little parts;) as being not ready to resolve it, till we had declared the manner of working of bodies one upon another. Here then will be a fit place to determine that, out of what we have discoursed concerning the actions, whereby bodies are made and corrupted: for considering the universal action of fire that runneth through all the bodies we have commerce withall, by reason of the suns influence into them and operation upon them with his light and beams which reacheth far and neer; and looking upon the effects which we have shewed do follow thence: it is manifest, there can not be any great quantity of any body whatsoever, in which fire is not intrinsically mixed. And on the other side, we see that where fire is once mixed it is very hard to separate it totally from thence. Again, we see it is impossible that pure fire should be conserved, without being adjoynd to some other body; both because of its violent nativity, still streaming forth with a great impetuosity; as also because it is so easily overcome by any obdient body when it is dilated. And therefore we may safely conclude, that no simple Element can consist in any great quantity in this course of nature which we live in and take a survey of. Neither doth it appear to what purpose nature should have placed any such storehouses of simples, seeing she can make all needful complexions by the dissolutions of mixed bodies into other mixed bodies favouring of the nature of the Elements, without needing their purity to begin upon.

But on the other side it is as evident that the Elements must remain pure in every compounded body in such extreme small parts as we use to call atoms: for if they did not, the variety of bodies would be nothing else, but so many degrees of rarity and density, or so many pure homogeneal Elements, and not bodies composed of heterogeneal parts: and consequently would not be able to shew that variety of parts which we see in bodies, nor could produce the complicated effects which proceed from them. And accordingly we are sure that the least parts which our senses can arrive to discover have many varieties in them: even so much that a whole living creature (whose organical parts must needs be of exceeding different natures) may be so little, as unto

our eyes to seem indivisible; we not distinguishing any difference of parts in it without the help of a multiplying glass: as in the least kind of mites, and in worms picked out of childrens hands we daily experience. So as it is evident that no sensible part can be unmingled. But then again, when we call to mind how we have shewed that the qualities which we find in bodies do result out of the composition, and mixtion of the Elements, we must needs conclude, that they must of necessity remain in their own essences in the mixed body. And so out of the whole discourse, determine that they are not there in any visible quantity, but in those least atoms, that are too subtile for our senses to discern. Which position we do not understand so Metaphysically as to say that their substantial forms remain actually in the mixed body; but only that their accidental qualities are found in the compound; remitting that other question unto Metaphysicians (those spiritual Anatomists) to decide.

CHAP. XVII.

Of Rarefaction and Condensation, the two first motions of particular bodies.

Our intention in this discourse, concerning the natures and motions of bodies, aiming no farther than at the discovery of what is or may be done by corporeal Agents; thereby to determine what is the work of immaterial and spiritual substances; and the following chap. it cannot be expected at our hands that we should deliver here an intire and compleat body of natural Philosophy. But only that we should take so much of it in our way, as is needful to carry us with truth and evidence to our journeys end. It belongeth not then to us to meddle with those sublime contemplations which search into the nature of the vast Universe, and that determine the unity and limitation of it; and that shew by what strings, and upon pins, and wheels, and hinges, the whole world moveth: and that from thence do ascend unto an awful acknowledgement and humble admiration of the primary cause; from whence, and of which, both the being of it, and the beginning of the first motion, and the continuance of all others doth proceed and depend.

I.
The Authours
intent in this
and the fol-
lowing chap.
ters.

Nor indeed would it be to the purpose for any man to fail in
M 2 this

Mr. Thomas
Bite.

this Ocean, and to begin a new voyage of navigation upon it : unless he were assured, he had ballast enough in his ship to make her sink deep into the water, and to carry her steddily through those unruly waves ; and that he were furnished with skill and provision sufficient to go through, without either losing his course by steering after a wrong compass, or being forced back again with short and obscure relations of discoveries: since others that went out before him, are returned with a large account to such as are able to understand and sum it up. Which surely our learned countreyman, and my best and most honoured friend, and to whom of all men living I am most obliged (for to him I owe that little which I know; and what I have, and shall set down in all this discourse, is but a few sparks kindled by me at his great fire) hath both profoundly, and acutely, and in every regard judiciously performed in his Dialogues of the world.

Our task then (in a lower strain, and more proportionate to so weak shoulders) is to look no farther than among those bodies we converse withall. Of which, having declared by what course and engines nature governeth their common motions, that are found even in the Elements, and from thence are derived to all bodies composed of them ; we intend now to consider such motions as accompany divers particular bodies, and are much admired by whosoever understandeth not the causes of them.

2.
That bodies
may be rarified,
both by
outward and
inward heat;
and how this
is performed.

To begin from the easiest and most connexed with the actions of the Elements, the hand of our labour will light upon the motions of *Rarefaction and Condensation*, as they are the passions of mixed bodies. And first for Rarefaction ; we may remember how it proceedeth originally from fire, and dependeth of heat ; as is declared in the former chapter : and wheresoever we finde Rarefaction, we may be confident the body which suffereth it, is not without fire working upon it. From hence we may gather, that when the air imprisoned in a baloon or bladder, swelleth against what containeth it, and stretcheth its case, and seeketh to break out, this effect must proceed from fire or heat (though we see not the fire) working either within the very bowels of the air, or without, by pressing upon what containeth it, and so making it self a way unto it.

And that this latter way is able to work this effect, may be

be convinced by the contrary effect from a contrary cause : for take a bladder stretched out unto its greatest extent by air shut up within it ; and hang it in a cold place ; and you will see it presently contract it self into a less room ; and the bladder will grow wrinkled, and become too big for the air within it. But for immediate proof of this position, we see that the addition of a very small degree of heat, rarifieth the air in a weather glass, (the air receiving the impression of heat, sooner than water) and so maketh it extend it self into a greater place ; and consequently, it presseth upon the water ; and forceth it down into a less room than formerly it possessed. And likewise we see quicksilver and other liquours, if they be shut up in glasses close stopped and set in sufficient heat (and a little is sufficient for this effect) they will swell and fill their glasses ; and at the last break them, rather than not find a way to give themselves more room ; which is then grown too straight in the glass, by reason of the rarefaction of the liquors by the fire working upon them.

Now again ; that this effect may be wrought by the inward heat, that is enclosed in the bowels of the substance thus shut up ; both reason and experience do assure us : for, they teach us that if a body which is not extremely compacted, but that by its looseness is easily divisible into little parts (such a one as wine, or other spiritual liquors) be inclosed in a vessel ; the little atoms that perpetually move up and down in every space of the whole world, making their way through every body, will set on work the little parts, in the wine for example, to play their game : so that the hot and light parts (if they be many) not enduring to be compressed and kept in by the heavie and cold ones, do seek to break out with force ; and till they can free themselves from the dense ones that would imprison them they carry them along with them, and make them to swell out as well as themselves,

Now if they be kept in by the vessel, so that they have not play enough ; they drive the dense ones (like so many little hammers or wedges) against the sides of it, and at the length do break it, and so do make themselves way, to a larger room. But if they have vent, the more fiery hot spirits fly away, and leave the other grosser parts quiet and at rest. On the other side, if the hot and light parts in a liquor be not many nor very active, and the vessel be so full that the parts have not free scope to remove

and make way for one another, there will not follow any great effect in this kind: as we see in bottled beer or ale, that worketh little, unless there be some space left empty, in the bottle. And again; if the vessel be very much too big for the liquor in it, the fiery parts find room, first to swell up the heavy ones, and at the length to get out from them; though the vessel be close stopped; for they have scope enough to float up and down between the surface of the liquor, and the roof of the vessel.

And this is the reason that if a little beer or small wine be left long in a great cask, be it never so close stopped, it will in time grow dead. And then, if at the opening of the bung (after the cask hath been long unstirred) you hold a candle close to it, you shall at the instant see a flash of flame environing the vent; Which is no other thing, but the subtile spirits that parting from the beer or wine, have left it dead; and flying abroad as soon as they are permitted, are set on fire by the flame that they meet with in their journey, as being more combustible (because more subtile) than that spirit of wine which is kept in form of liquor: and yet that likewise (though much grosser) is set on fire by the touch of flame. And this happeneth not onely to wine, and beer, or ale, but even to water; As dayly experience sheweth in the East-Indian ships, that having been 5 or 6 years at sea, when they open some of their casks of Thames-water in their return homewards (for they keep that water till the last, as being their best and most durable, and that groweth lighter, and purer, by the often putrifyings through violent motions in storms, every one of which maketh new gross and earthy parts fall down to the bottom, and other volatile ones ascend to the top;) a flame is seen about their bungs if a candle be near, as we said before of wine.

And to proceed, with confirming this doctrine by farther experience; we dayly see that the little parts of heat being agitated and brought into motion in any body, they enter and pierce into other parts, and incorporate themselves with them, & set them on fire if they be capable thereof: as we see in wet hay or flax laid together in great quantity. And if they be not capable of taking fire, then they carry them with them to the outside; & when they can transport them no farther, part flies away, & other part staies
with

with them: as we see in new beer or ale. & in must of wine; in wch, a substance usually called the mother, is wrought up to the top.

Which in wine, will at the last be converted into Tartar, when the spirits that are very volatile, are flown away, and do leave those parts from whence they have evaporated, more gross and earthy than the others, where the grosse and subtiler parts continue still mixed. But in beer, or rather in ale, this mother, which in them we call barm, will continue longer in the same consistence and with the same qualities; for the spirits of it are not so fiery that they must presently leave the body they have incorporated themselves withall; nor are hot enough to bake it into a hard consistence. And therefore bakers make use of it to raise their bread; which neither it will do, unless it be kept from cold; both which, are evident signes that it works in force of heat; and consequently, that it continueth still a hot and light substance.

And again we see, that after wine or beer hath wrought once, a violent motion will make it work anew. As is dayly seen in great lightnings and in thunder, and by much rocking of them; for such motion rarifieth, and consequently heateth them: partly by separating the little parts of the liquour, which were before as glewed together, and therefore lay quietly; but now, by their pulling asunder, and by the liquors growing thereby more loose than it was, they have freedome to play up and down: and partly by beating one part against another, which breaketh and divideth them into lesser atoms, & so bringeth some of them into the state of fire; which you may remember, is nothing else but a body brought into such a degree of littleness and rarity of its parts.

And this is the reason why such hard and dry bodies as have an unctuous substance in them, are by motion either easily set on fire, or at the least, fire is easily gotten out of them. As happeneth in flints, and in divers other stones, which yeeld fire when they are stricken; and if presently after you smell unto them, you shall perceive an odour of brimstone and of burning, which is a certain signe that the motion did convert into fire the natural brimston that was mingled with the flint, and whose denser parts were grown cold, and so stuck to the stone. And in like manner, the ivywood and divers others, as also the Indian canes (which from thence are called firecanes) being rubbed with some other stick of the same nature, if they be first very dry, will

of themselves set on fire: and the like will happen to coach-wheels in the summer if they be overheated with motion.

3.
Of the great
effects of Ra-
refaction.

To conclude our discourse of rarefaction, we may look a little into the power and efficacy of it, which is no where to be seen so clearly as in fire. And as fire is the general cause of rarefaction, so is it of all bodies that which is most rarefied. And therefore it is no marvail if its effects be the greatest that are in nature, seeing it is the proper operation of the most active Element. The wonderfull force of it we dayly see in thunder, in guns, in granadoes, and in mines; of which, continuall experience, as well as severall histories witnesse little less than miracles. Leaving them to the remarks of curious persons, we will onely look into the way by which so main effects do proceed from causes that appear so slender.

It is evident that fire (as we have said before) dilateth it self spherically; as nature sheweth us manifestly in bubbles of boyling water, and of milk, and generally of such substances as are of a viscuous composition; for those bubbles being round, do assure us that the cause which made them, did equally dilate them from the center unto all parts. Now then remembering the infinite multiplication which is in fire, we may conceive that when a grain of gun-powder is turned thereinto, there are so many little bubbles of a viscuous substance one backing another with great celerity, as there are parts of fire more than there were of gun-powder. And if we make a computation of the number and of the celerity of these bubbles, we shall find that although every one of them single do seem to be of an inconsiderable force, yet the whole number of them together, will exceed the resistance of the body moved or broken by them: especially, if we note, that when hard substances have not time allowed them to yield, they break the sooner. And then we shall not so much admire the extremities we see acted by these means.

4.
The first man-
ner of conden-
sation, by heat.

Thus having looked into the nature of rarefaction, and traced the progress of it from the motion of the sun and fire; in the next place we are to examine the nature of condensation. And we shall often-times finde it likewise an effect of the same cause otherwise working: for there being two different wayes to dry any wet thing; the one, by taking away that juyce which maketh a body liquid; the other, by putting more drought to the wet body,

dy, that it may imbibe the moisture; this latter way doth, as well as the former, condense a body: for by the close sticking of wet to dry, the moist part of condensation is effected in compounded bodies.

The first of these waies, doth properly and immediately proceed from heat; for heat entring into a body, incorporateth it self with the moist and viscous parts it findeth there: as purging medicines do with the humours they work upon; which when the stomack can no longer entertain (by reason of their unruly motions in resting together) they are both ejected grappling with one another; and the place of their contention is thus, by the supervenience of a guest of a contrary nature (that will not stay long there) purged from the superabundance of the former ones that annoyed it. Even so, the fire that is greedily drunk up by the watry and viscous parts of a compounded body; and whose activity and restless nature will not endure to be long imprisoned there, quickly pierceth quite through the body it entereth into; and after a while streameth out at the opposite side, as fast as it entered in on the side next to it, and carrieth away with it those glewy parts it is incorporated with: and by their absence, leaveth the body they part from, dryer than at the first it was.

Which course we may observe in sirrups that are boyled to a consistence, and in broths that are consumed unto a jelly: over which, whiles they are making by the fire under them, you see a great steam; which is, the watry parts that being incorporated with fire, flie away in smoke. Likewise when the sea-water is condensed into salt, you see it is an effect of the sun or fire that exhalteeth or boylteth away all the palpable moisture. And so when wet cloths are hanged either in the sun or at the fire, we see a smoke about the cloths, and heat within them; which being all drawn out from them, they become dry.

And this deserveth a particular note, that although they should be not quite dry, when you take them from the fire; yet by then they are cool, they will be dry: for the fire that is in them when they are removed from the main stock of fire, flying away, carrieth with it the moisture that was incorporated with it: and therefore whiles they were hot, that is, whiles the fire was in them they must also be moist; because the fire and the moisture were
grown

grown to be one body: & could not become through dry with that measure of fire, (for more would have dried them, even whilst they were hot) untill they were also grown through cold. And in like manner, sirupes, hydromels, gellies, and the like, grow much thicker after they are taken off from the fire, than they were upon the fire, and much of their humidity flieth away with the fire, in their cooling, whereby they lessen much of their quantity, even after the outward fire hath ceased from working upon them.

Now if the moist parts, that remain after the drying, be by the heat well incorporated in the dry parts; and so do occasion the dry parts to stick close together; then that body is condensed, and will (to the proportion of it) be heavier in a less bulk; as we see that metals are heavier than stones.

5.
The second
manner of
condensation
by cold.

Although this effect be in these examples wrought by heat, yet generally speaking it is more proper to cold: which is the second way of drying a moist body. As when in *Greenland* the extreme cold freezes the whalefishers beer into ice, so that the stewards divide it with axes and wedges, and deliver their portions of drink to their ships company, and their shallopes gings in their bare hands: but in the innermost part of the butt, they find some quantity of very strong liquor, not inferior to moderate spirite of wine. At the first, before custome had made it familiar unto them, they wondered that every time they drew at the tap, when first it came from their ships to the shore (for the heat of the hold would not let it freeze) no liquor would come, unless they new tapped it with a longer gimlet: but they thought that pains well recompensed, by finding it by the tast to grow stronger and stronger, till at the last, their longest gimlets would bring nothing out; and yet the vessel not a quarter drawn off; which obliged them then to flave the cask, that so they might make use of the substance that remained.

The reason of this, is evident: that cold seeking to condense the beer by mingling its dry and cold parts with it, those that would indure this mixture, were imbibed and shrunk up by them. But the other rare and hot parts that were squeezed out by the dense ones which entered to congeal the beer, and were forced into the middle of the vessel (which was the farthest part for them to retire unto, from their invironing enemies) did con-

serve

serve themselves in their liquid form, in defiance of the assaulting cold; whilst their fellows, remaining by their departure more gross and earthy than they were before, yeilded to the conquerour, they could not shift away from, and so were dryed and condensed in ice: which when the mariners thawed, they found it like fair water, without any spirits in it, or comforting heat to the stomach.

This manner of condensation, which we have described in the freezing of beer, is the way most practised by nature; I mean, for immediate condensation (for condensation is secondarily, where-soever there is rarefaction, which we have determined to be an effect of heat.) And the course of it is: that a multitude of earthy and dry bodies being driven against any liquour, they easily divide it, by means of their density, their dryness, and their littleness (all which in this case do accompany one another, and are by us determined to be powerfull dividers;) and when they are gotten into it, they partly suck into their own pores the wet and diffused parts of the liquid body; and partly they make them (when themselves are full) stick fast to their dry sides, and become as a glew to hold themselves strongly together. And thus they dry up the liquor; and by the natural pressing of gravity they contract it into a lesser room. No otherwise than when we force much wind or water into a bottle; and by pressing it more and more, make it lie closer than of its own nature it would do. Or rather, as when ashes being mingled with water, both those substances do stick so close to one another, that they take up less room than they did each apart.

This is the method of frosts, and of snow, and of ice, both natural and artificial; for in natural freezing, ordinarily the north or north-east wind by its force bringeth and driveth into our liquours, such earthy bodies as it hath gathered from rocks covered with snow; which being mixed with the light vapours whereof the wind is made, do easily find a way into the liquors, and then they dry them into that consistence which we call ice. Which in token of the wind it hath in it, swimmeth upon the water, and the vessel where it was made, riseth higher than the water did whereof it is composed: and ordinarily it breaketh from the sides of the vessel, so giving way to more wind to come in, and freeze deeper and thicker.

But

3. But because *Galileus, Nel discorso intorno alle cose che stanno in su l'acqua, pag. 4* was of opinion that yce was water rarified, and not condensed; we must not pass over this verity, without maintaining it against the opposition of so powerfull an adversary. His arguments are, first that yce taketh up more place than the water did of which it was made; which is against the nature of condensation. Secondly, that quantity for quantity yce is lighter than water; whereas things that are more dense are proportionally more heavy. And lastly, that yce swimmeth in water, whereas we have often taught, that the more dense descendeth in the more rare.

That yce is
not water rari-
fied but con-
densed.

Now to reply to these arguments, we say first, that we would gladly know how he did to measure the quantity of the yce, with the quantity of the water of which it was made; & then when he hath shewed it, and shewed withall that yce holdeth more place than water; we must tell him that his experiment concludeth nothing against our doctrine, because there is an addition of other bodies mingled with the water to make yce of it, as we touched above; and therefore that compound may well take up a greater place than the water alone did, and yet be denser than it; and the water also be denser than it was.

And that other Bodies do come into the water and are mingled with it, is evident out of the exceeding coldness of air, or some very cold wind; one of which two never misseth to reign whensoever the water freezeth: and both of them do argue great store of little earthy dry bodies abounding in them, which sweeping over all those that lie in their way and course, must of necessity be mixed with such as give them admittance, which water doth very easily. And accordingly we see that when in the freezing of water the yce groweth any thing deep, it either shrinketh about the borders, or at the least lieth very loose, so as we cannot doubt but that there is a free passage for more of such subtile bodies to get still to the water, and freez it deeper.

To his second argument, we ask how he knoweth that yce quantity for quantity, is lighter than water? for although of a sponge that is full of water, it be easie to know what the sponge weigheth, and what the water that was soaked into it, because we can part the one of them from the other, and keep each a part to examine their weights, yet to the like between yce and water,

water, if ice be throughout full of air (as of necessity it must be) we believe impossible. And therefore it may be lighter in the bulk than water, by reason of the great pores caused in it, through the shrinking up of the parts of water together (which pores must then necessarily be filled with air) and yet every part by it self (in which no air is) be heavier than so much water.

And by this it appeareth that his last argument (grounded upon the swimming of ice in water) hath no more force than if he would prove that an iron or an earthen dish, were lighter, and consequently more rare than water, because it swimmeth upon it; which is an effect of the air being contained in the belly of it (as it is in ice) not a sign of the metals being more rare than water.

Whereas on the contrary side, the proof is positive and clear for us; for it cannot be denied, but that the mingling of the water with other bodies more dense than it, must of necessity make the compound and also the water it self become more dense than it was alone. And accordingly we see, that ice half thawed (for then much of the air is driven out, and the water beginneth to fill the pores wherein the air recided before) sinketh to the bottom: as an iron dish with holes in it (whereby the water might get into it) would do. And besides, we see that water is more diaphanous than ice, and ice more consistent than water. Therefore I hope we shall be excused, if in this particular we be of a contrary opinion to this great personage.

But to return unto the third of our discourse. The same that passeth here before us, passeth also in the sky with snow, hail, rain, and wind. Which that we may the better understand, let us consider how winds are made: for they have a main influence into all the rest. When the Sun by some particular occurrent raiseth great multitudes of atoms from some one place, and they either by the attraction of the Sun, or by some other occasion, do take their course a certain way; this motion of those atoms we call a wind: which according to the continuance of the matter from whence these atoms rise, endureth a longer or a shorter time, and goeth a farther or a shorter way, like a river, or rather like those eruptions of waters, which in the Northern parts of England they call *Gypsies*: the which do break out at uncertain times, and upon uncertain causes, and flow likewise with an.

7.

How wind,
snow, and hail
are made; and
wind by rain
allaid.

an uncertain duration. So these winds being composed of bodies in a determinate proportion heavier than the air, do run their course from their height to the ground, where they are supported (as water is by the floor of its chanel) whiles they perform their career; that is, until they be waisted either by the drawing of the sun, or by their sticking and incorporating into grosser bodies.

Some of these winds according to the complexion of the body out of which they are extracted, are dry; as those which come from barren mountains covered with snow: others are moist; as those that come out of marishy or watry places: others have other qualities; as of heat, or cold, of wholsomness, or unwholsomness, and the like; partly from the source, and partly from the bodies they are mingled with in their way.

Such then being the nature and origine of winds: if a cold one do meet in the air with that moist body whereof otherwise rain would have been made, it changeth that moist body into snow or into hail; if a dry winde meet with a wet body it maketh it more dry, and so hindreth the rain that was likely to be: but if the wet body overcome the dry wind, it bringeth the wind down along with it; as we see when a shower of rain allaieth a great winde.

And that all this is so, experience will in some particulars instruct us as well as reason, from whence the rest may be evidently inferred. For we see that those who in imitation of nature would convert water into ice, do take snow or ice & mingle it with some active dry body, that may force the cold parts of the snow from it; and then they set the water (in some fit vessel) in the way that those little bodys are to take, which by that means entring into it, do strait incorporate themselves therewith, & of a sudden do convert it into ice. Which process you may easily try, by mingling salt armoniak with the snow; but much more powerfully by setting the snow over the fire, whiles the glass of water to be congealed stands in it after the manner of an egge in salt. And thus fire it self, though it be the enemy and destroyer of all cold, is made the instrument of freezing. And the same reason holdeth in the cooling of wine with snow or ice, when after it hath been a competent time in the snow, they whose charge it is, do use to give the vessel that containeth the wine, three or four turns in the snow; so to mingle through the whole body of the wine, the cold

cold received first but in the outward parts of it, and by pressing, to make that without have a more forcible ingression.

But the whole doctrine of *Meteors* is so amply, so ingeniously, and so exactly performed by that never enough praised Gentleman *Monfieur Des Cartes* in his Meteorological discourses; as I should wrong my self and my Reader, if I dwelled any longer upon this subject. And whose Physical discourses, had they been divulged before I had entred upon this work, I am perswaded would have excused the greatest part of my pains in delivering the nature of bodies.

8.

How parts of the same or divers bodies are joyned together by condensation.

It were a fault to pass from treating of condensation, without noting so ordinary an effect of it as is the joyning together of parts of the same body, or of divers bodies. In which we see for the most part that the solid bodies which are to be joyned together, are first either heated or moistened, that is, they are rarified: and then they are left to cold air or to other cold bodies to thicken and condense (as above we mentioned of sirrups and jellies;) and so they are brought to stick firmly together. In the like manner we see that when two metals are heated till they be almost brought to running, and then are pressed together by the hammer, they become one continued body. The like we see in glass, the like in wax, and in divers other things. On the contrary side; when a broken stone is to be pieced together, the pieces of it must be wetted, and the ciment must be likewise moistened, and then joyning them aptly, and drying them, they stick fast together. Glew is moistened, that it may by drying afterwards hold pieces of wood together. And the spectacle-makers have a composition which must be both heated and moistened, to joyn unto handles of wood the glass which they are to grinde. And broken glasses are cimented with cheese and chalk or with garlick.

All these effects our sense evidently sheweth us, arise out of condensation; but to our reason it belongeth to examine particularly by what steps they are performed. First then we know that heat doth subtilize the little bodies which are in the pores of the heated body; and partly also it openeth the pores of the body it self, if it be of a nature that permitteth it; as it seemeth those bodies are, which by heat are mollified or are liquefactible. Again, we know that moisture is more subtile to enter into small creeks than

than dry bodies are; especially when it is pressed; for then it will be divided into very little parts, and will fill up every little chink; and nevertheless if it be of a gross and viscuous nature, all the parts of it will stick together. Out of these two properties we have, that since every body hath a kind of orb of its own exhalations, or vapors round about it self (as is before declared,) the vapors which are about one of the bodies, will more strongly and solidly (that is, in more abundant and greater parts) enter into the pores of the other body against which it is pressed when they are opened and dilated: and thus they becoming common to both bodies, by flowing from the one, and streaming into the other, and sticking to them both, will make them stick to one another. And then as they grow cold and dry, these little parts shrink on both sides; and by their shrinking draw the bodies together; and withall do leave greater pores by their being compressed together, than were there when by heat and moisture they were dilated; into which pores the circumstances cold parts do enter, and thereby do as it were wedge in the others; and consequently do make them hold firmly together the bodies which they joyn.

9. But if art or nature should apply to this juncture any liquor or vapor, which had the nature and power to insinuate it self more efficaciously to one of these bodies, than the glew which was between them did; of necessity in this case these bodies must fall in pieces. And so it happeneth in the separation of metals by corrosive waters; as also in the precipitation of metals or of salts when they are dissolved in such corrosive waters, by means of other metals or salts of a different nature: in both which cases the entrance of a latter body that penetrateth more strongly, and uniteth it self to one of the joyned bodies, but not to the other, teareth them asunder, and that which the piercing body rejecteth, falleth into little pieces; and if formerly it were joyned with the liquor, it is then precipitated down from it in a dust.

Out of which discourse we may resolve the question of that learned and ingenious man *Petrus Gassendus*; who by experience found, that water impregnated to fulness with ordinary salt, would yet receive a quantity of other salt; and when it would imbibe no more of that, would nevertheless take into it a proportion of a third; and so of several kinds of salts one after

Vacities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.

ter another : which effect he attributed to vacuities or porous spaces of divers figures, that he conceived to be in the water ; whereof some were fit for the figure of one salt, and some for the figure of another. Very ingeniously ; yet if I miss not my mark most assuredly he hath missed his.

For first, how could he attribute divers sorts of vacuities to water without giving it divers figures ? And this would be against his own discourse, by which every body should have one determinate natural figure.

Secondly, I would ask him if he measured his water after every salting ? and if he did, whether he did not find the quantity greater, than before that salt was dissolved in it ? Which if he did (as without doubt he must) then he might safely conclude that his salts were not received in vacuities ; but that the very substance of the water gave them place, and so encreased by the receiving of them.

Thirdly, seeing that in his doctrine every substance hath a particular figure ; we must allow a strange multitude of different shapes of vacuities to be naturally in water ; if we will have every different substance wherewith it may be impregnated (by making decoctions, extractions, solutions, and the like) to find a fit vacuity in the water to lodge it self in. What a difform net with a strange variety of meshes wou'd this be ? And indeed how extremely incapable must it be of the quantity of every various kind of vacuity that you will find must be in it ; if in every solution of one particular substance, you calculate the proportion between it and the water that dissolveth it, and then multiply it according to the number of several kinds of substances that may be dissolved in water ? By this proceeding, you will find the vacuities to exceed infinitely the whole body of the water ; even so much that it could not afford subtile thrids enough to hold it self together.

Fourthly, if this doctrine were true it would never happen that one body or salt should precipitate down to the bottom of the water, by the solution of another in it, which every Alchymist knoweth, never faileth in due circumstances : for seeing that the body which precipitateth, and the other which remaineth dissolved in the water, are of different figures, and therefore do require different vacuities, they might both of them have kept their pla-

ces in the water, without thrusting one another out of it.

Lastly, this doctrine giveth no account why one part of salt is separated from another by being put in the water, and why the parts are there kept so separated, which is the whole effect of that motion which we call dissolution.

10. The true reason therefore of this effect, is (as I conceive) that one salt maketh the water apt to receive another; for the lighter salt being incorporated with the water, maketh the water more proper to stick unto an heavier, and by dividing the small parts of it to bear them up, that otherwise would have sunk in it. The truth and reason of which will appear more plain, if at every joynt we observe the particular steps of every salts solution. As soon as you put the first salt into the water, it falleth down presently to the bottom of it; and as the water doth by its humidity pierce by degrees the little joynts of this salt, so the small parts of it are by little and little separated from one another, and united to parts of water. And so infusing more and more salt, this progress will continue, until every part of water is incorporated with some part of salt: and then, the water can no longer work of it self but in conjunction to the salt with which it is united. After which, if more salt of the same kinde be put into the water, that water so impregnated, will not be able to divide it; because it hath not any so subtiler parts left, as are able to enter between the joynts of a salt so closely compacted: but may be compared to that salt, as a thing of equal drincss with it; and therefore is unapt to moisten and pierce it.

But if you put into this compound of salt and water, another kind of salt that is of a stronger and a drier nature than the former, and whose parts are more grossly united; then the first salt dissolved in the water, will be able to get in betwixt the joynts of the grosser salt, and will divide it into little parts; and will incorporate his already composed parts of salt and water into a decompound of two salts and water; until all his parts be a new impregnated with the second grosser salt; as before, the pure water was with the first subtiler salt. And so it will proceed on, if proportionate bodies be joyned, until the dissolving composition do grow into a thick body.

Unto which discourse we may add, that when the water is so fully impregnated with the first salt, as it will receive no more,

maining in the temper it is in; yet if it be heated, it will then a fresh dissolve more of the same kind. Which sheweth, that the reason of its giving over to dissolve, is for want of having the water divided into parts little enough to stick unto more salt: which, as in this case the fire doth; so peradventure in the other, the acrimoniousness of the salt doth it.

And this is sufficient to give curious wits occasion by making farther experiments, to search out the truth of this matter. Onely we may note what hapneth in most of the experiencies we have mentioned; to wit, that things of the same nature do joyn better and more easily than others that are more estranged from one another. Which is very agreeable to reason; seeing that if nature do intend to have things consist long together, she must fit them for such consistence.

11.

The reason why bodies of the same nature do joyn more easily together than others.

Which seemeth to proceed out of their agreement in four qualities; first, in weight: for bodies of divers degrees in weight, if they be at liberty, do seek divers places; and consequently substances of like weight, must of necessity finde one another out, and croud together; as we have shewed, it is the nature of heaviness to make them do: now it is apparent that things of one nature, must in equal parts have the same or a neer proportion of weight, seeing that in their composition, they must have the same proportion of Elements.

The second reason of the consistence of bodies together, that are of the same nature, is, the agreement of their liquid parts, in the same degree of rarity and density: for as it is the nature of quantity in common to make all parts be one quantity; so it is the nature of the degrees of quantity, when two parts do meet that are of the same degree, to make them one in that degree of quantity; which is, to make them stick together in that degree of sticking, which the degree of density that is common to them both, maketh of its own nature. Whereas, parts of different densities, cannot have this reason of sticking: though, peradventure they may upon some other ground, have some more efficacious one. And in this manner, the like humid parts of two bodies, becoming one, the holes or receptacles in which those humid parts are contained must also needs be united.

The third reason is the agreeable proportion, which their several figures have in respect of one another: for if any humidi-

ty be extracted out of a mix'd body, especially, by the virtue of fire; it must have left pores of such figures, as the humidity that is drawn out of them, is apt to be cut into (for every humid body not being absolutely humid, but having certain dry parts mix'd with it, is more apt for one kind of figure and greatness, than for another;) and by consequence, whensoever that humidity shall meet again with the body it was severed from, it will easily run through and into it all, and will fill exactly the cavities and pores it possess'd before.

The last quality, in which bodies that are to consist long together, do agree, is the bigness of the humid and dry parts of the same body: for if the humid parts be too big for the dry ones, it is clear that the dry ones must needs hang loosely together by them; because their glew is in too great a quantity. But if the humid parts be too little for the dry ones, then of necessity some portion of every little dry part must be unfurnish'd of glew, by means whereof to stick unto his fellow; and so the sticking parts not being conveniently proportioned to one another, their adhesion cannot be so solid as if each of them were exact'y fitted to his fellow.

CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations, termed Magical.

I.
What Attraction is, and from whence it proceedeth.

HAVING thus ended the two motions of rarefaction and of condensation; the next that offer themselves, are the local motions which some bodies have unto others. These are sometimes performed by a plain force in the body towards which the motion is: and other whiles by a hidden cause, which is not so easily discerned. The first, is chiefly that which is ordinarily said to be done by the force of nature to hinder vacuum, and is much practis'd by nature; as in drawing our breath, in sucking, and in many other natural operations, which are imitated by art in making of pumps, syphons, and such other instruments; and in that admirable experiment of taking up a heavy marble stone meerly by another lying flat and smoothly upon it, without any other connexion of the two stones together; as also by that sport of boys, when they spread a thin moistned leather upon a smooth broad stone, and press it all over close to it, and then by pulling of a string fastned at the middle of the leather,

leather, they draw up likewise the heavy stone. In all which, the first cause of the motion proceedeth from that body towards which the motion is made. And therefore is properly called *Attraction*.

For the better understanding and declaring of which, let us suppose two marble stones, very broad and exceeding smoothly polished to be laid one flat upon the other: and let there be a ring fastned at the back part of the uppermost stone; and exactly in the middle of it. Then by that ring, pull it up perpendicularly, and steadily, and the undermost will follow sticking fast to the overmost; and though they were not very perfectly polished, yet the nethermost would follow for a while, if the ring be suddenly plucked up; but then it will soon fall down again. Now this plainly sheweth that the cause of their sticking so strongly together, when both the stones are very well polished, is for that nothing can well enter between them to part them; and so, it is reduced to the shortness of the air that is betwixt them: which not being capable of so great an expansion, nor admitting to be divided thick-waies so much as is necessary to fill the first growing distance, between the two stones, till new air findeth a course thither (that so, the swelling of the one, may hinder vacuity, till the other come into the rescue;) the two stones must needs stick together to certain limits; which limits will depend of the proportion that is between the weight, and the continuity of the nethermost stone.

And when we have examined this, we shall understand in what sense it is meant that *Nature abhorreth from Vacuity*, and what means she useth to avoid it. For, to put it as an enemy of the Maxim, that nature fighteth against; or to discourse of effects that would follow from it, in case it were admitted, is a great mistake, and a lost labour; seeing it is nothing; and therefore, can do nothing: but is meerly a form of expression to declare in short nothing else but that it is a contradiction, or implication in terms, and an impossibility in nature, for vacuity to have, or be supposed to have a *Being*.

Thus then, since in our case, after we have cast all about, we can pitch upon nothing to be considered, but that the two stones do touch one another, and that they are weighty; we must apply ourselves onely to reflect upon the effects proceeding from these two causes, their contiguity and their heaviness; and we shall finde

that as the one of them, namely the weight, hindereth the undermost from following the uppermost, so, contiguity obligeth it unto that course; and according as the one overcometh the other, so will this action be continued or interrupted.

Now that contiguity of substances do make one follow another, is evident by what our Masters in Metaphysics teach us; when they shew that without this effect no motion at all could be made in the world, nor no reason could be given, for those motions we daily see. For since the nature of quantity is such, that whensoever there is nothing between two parts of it, they must needs touch and adhere and joyn to one another, (for how should they be kept asunder when there is nothing between them to part them?) if you pull one part away, either some new substance must come to be close unto that which removeth; or else the other which was formerly close to it, must still be close to it, and so follow it: for if nothing do come between, it is still close to it. Thus then, it being necessary that something must be joyned close to every thing; vacuity, (which is nothing) is excluded from having any being in nature.

And when we say that one body must follow another to avoid vacuity; the meaning is, that under the necessity of a contradiction they must follow one another, and that they cannot do otherwise. For it would be a contradiction to say that nothing were between two things and yet that they are not joyned close to one another. And therefore if you should say it, you would in other words say, they are close together, and they are not close together. In like manner, to say that vacuity is any where, is a pure contradiction; for vacuity being nothing hath no *Being* at all: and yet by those words it is said to be in such a place; so that they affirm it *to be* and *not to be*, at the same time.

3.
The true reason of attraction.
But now let us examine if there be no means to avoid this contradiction and vacuity, other than by the adhesion, and following of one body upon the motion of another, that is closely joyned to it and every where contiguous. For sense is not easily quieted with such Metaphysical contemplations, that seem to repugn against her dictaments; and therefore for her satisfaction we can do no less than give her leave to range about, and cast all waies in hope of finding some one that may better content her: which when she findeth that she cannot she will the less repine to.

to yield her assent to the rigorous sequels and proofs of reason.

In this difficulty then, after turning on every side, I for my part can discern no pretence of probability, in any other means than in pulling down the lower stone by one corner; that so there may be a gaping between the two stones, to let in air by little and little. And in this case you may say that by the intervention of air, vacuity is hindered, and yet the lower stone is left at liberty to follow its own natural inclination, and be governed by its weight. But indeed, if you consider the matter well, you will find that the doing this, requireth a much greater force, than to have the lower stone follow the upper: for it cannot gape in a straight line, to let in air; since in that position, it must open at the bottom where the angle is made, at the same time that it openeth at the mouth: and then air requiring time to pass from the edges to the bottom, it must in the mean while fall into the contradiction of vacuity. So that if it should open to let in air; the stone, to compass that effect, must bend, in such sort as wood doth when a wedge is put into it to cleave it.

Judge then what force it must be that should make hard marble of a great thickness bend like a wand; and whether it would not rather break and slide off, than do so: you will allow that a much less, will raise up the lower stone together with the uppermost. It must then of necessity fall out, that it will follow it, if it be moved perpendicularly upwards. And the like effect will be though it should be raised at oblique angles, so that the lowermost edge do rest all the way upon something that may hinder the inferior stone from sliding aside from the uppermost.

And this is the very case of all those other experiments of art and nature, which we have mentioned above: for the reason holdeth as well in water and liquid things; as in solid bodies, until the weight of the liquid body overcometh the continuity of it: for then, the third breaketh, and it will ascend no higher.

4.

Water may be brought by the force of attraction to what height soever.

Which height, *Galileo* telleth us from the workmen in the Arsenal of Venice, is 40. foot; if the water be drawn up in a close pipe, in which the advantage of the sides helpeth the ascent. But others say that the invention is enlarged, and that water may be drawn to what height one pleaseth. Howsoever, the force which nature applieth to maintain the continuity of quantity, can have no limit, seeing it is grounded upon contradiction.

And therefore *Galileo* was much mistaken, when he thought to make an instrument whereby to discover the limits of this force.

We may then conclude, that the breaking of the water must depend from the strength of other causes. As for example, when the gravity is so great by increasing the bulk of the water, that it will either overcome the strength of the pipe, or else make the sucker of the pump rather yield way to air, than draw up so great a weight : for which defects, if remedies be found, the art may surely be enlarged without end.

5.
The doctrine
touching the
attraction of
water in sy-
phons.

This is particular in a syphon; that when that arm of it which hangeth out of the water is lower than the superficies of the water; then, it will run of it self; after it is once set on running by sucking. The reason whereof is, because the weight which is in the water pendant, is greater than the weight of the ascending water; and thereby supplieth the want of a continual sucker. But if the nose of that arm that hangeth out of the water, be but even, with the water; then the water will stand still in both pipes, or arms of the syphon, after they are filled with sucking. But if by the running out of the water, the outward pipe do grow shorter than to reach as low as the superficies of the water in the fountain from whence it runneth; in this case, the water in each arm of the syphon, will run back into the fountain.

Withall, it is to be noted, that though the arm which is out of the water be never so long, yet if it reach not lower than the superficies of the fountain; the overquantity and weight of the water there, more than in the other arm, helpeth it nothing to make it run out. Which is, because the declivity of the other arm over-recompenceth this over-weight. Not that the weight in the shorter pipe hath so much force as the weight in the longer pipe; but because it hath more force than the greater weight doth exercise there in its running; for the greatest part of its force, tendeth another way than to the end of the pipe; to wit, perpendicularly towards the center. And so is hindered from effect, by the great sloping or little declivity of the pipe upon which it leaneth.

6.
That the sy-
phon doth not
prove water
to weigh in its
own orb.

But some considering how the water that is in the longe arm of the syphon is more in quantity than the water that is in the other arm of it whereat it runneth out, do admire why the greater quantity of water doth not draw back the less into the cistern.

cistern, but suffreth it self to be lifted up, and drained away as if it run steeply downwards. And they imagine, that hence may be deduced, that the parts of water in the cistern do not weigh as long as they are within the orb of their own body.

Unto whom we answer; that they should consider how that to have the greater quantity of water, which is in the longer arm of the syphon (which arm is immersed in the water of the cistern) to draw back into the cistern the water which is in the other arm of the syphon that hangeth out in the air; it must, both raise as much of the water of the cistern as its own bulk is, above the level which at present the whole bulk of water hath; and withall it must at the same time pull up the water which is in the other arm. Now it is manifest, that these two quantities of water together, are heavier than the water in the sunk arm of the syphon; since one of them single, is equal unto it. And by consequence, the more water in the sunk arm cannot weigh back the less water in the hanging arm; since that, to do that, it must at the same time weigh up over and above, as much more in the cistern as it self weigheth.

But turning the argument; I say, that if once the arm of the syphon that is in the air, be supposed to draw any water, be it never so little, out of the cistern (whether occasioned by sucking or by whatsoever other means) it followeth that as much water as is drawn up, above the level of the whole bulk in the cistern, must needs press into the sunken arm from the next adjacent parts, (that is, from the bottom) to supply its emptying; and as much must of it self press down from above (according to its natural course, when nothing violenteth it) to rest in the place, that the ascending water (which is lower than it) leaveth at liberty for it to take possession of. And then it cannot be doubted, but that, this descending water, having all its weight in pressing down applied to drive up the rising water in the sunk arm of the syphon; & the water in the other arm of the syphon without, having all its weight in running out applied at the same time to draw up the same water in the sunk arm; this single resistant must yield to their double & mastering force. And consequently, the water in the arm of the syphon that is in the air, must needs draw the water that is in the other immersed arm as long as the end of its pipe reacheth lower than the level of the water in the cistern; for so long.

long it appeareth by what we have said, it must needs be more weighty; since part of the rising water in the sunk arm of the syphon, is counterpoised by as much descending water in the cistern

And thus it is evident, that out of this experiment it cannot be inferred that parts of water do not weigh within the orb of their own whole: but onely, that two equal parts of water in their own orb (namely that which riseth in the sunken arm, and that which presseth down from the whole bulk in the cistern) are of equal weight, and do ballance one another. So that never so little oddes between the two counterpoising parcels of water which are in the air must needs make the water run out at that end of the syphon, where the overweight of water is.

7.
Concerning
attraction
caused by fire.

The attraction whose cause next to this is most manifest, is that which is made by the force of heat or of fire; for we see that fire ever draweth air unto it; so notably, that if in a close room there be a good fire, a man that standeth at the door or at the window (especially without) shall hear such a noise that he will think there is a great wind within the chamber. The reason of this attraction is, that fire rarifying the air which is next unto it; and withall spending it self perpetually, causeth the air, and his own body mingled together, to flie up through the chimney or by some other passage. Whence it followeth of necessity that the next body must succeed into the place of the body that is flown away. This next body generally is air, whose mobility and fluidity beyond all other bodies, maketh it of all others the fittest to be drawn; and the more of it that is drawn the more must needs follow. Now if there be floting in this air any other atoms subject to the current which the air taketh; they must also come with it to the fire, and by it, must be rarified, and be exported out of that little orb.

Hence it is, that men (with very good reason) do hold that fire aireth a chamber, as we term it, that is, purifieth it, both because it purifieth it as wind doth by drawing a current of air into it that sweepeth through it, or by making it purifie it self by motion, as a stream of water doth by running; as also, because those vapors which approach the fire, are burned and dissolved. So that the air being noisome and unwholesome by reason of its grossness, proceeding from its standing unmoved (like a stagnation of dead water, in a marish place) the fire taketh away that cause of annoiance.

By

By this very rule we learn that other hot things, which participate the nature of fire, must likewise (in other respects) have a resemblance in this quality. And accordingly we see that hot loafs in a bakers shop newly drawn out of the oven, are accounted to draw unto them any infection which is in the air. The like we say of onions, & other strong breathing substances; which by their smell shew much heat in them. In like manner it is conceived that pigeons, and rabbits, and cats easily take infection, by reason of their extraordinary warmth which they have in themselves.

8.

Concerning
attraction
made by vir-
tue of hot bo-
dies, amulets,
&c.

And this is confirmed by the practise of Physicians, who use to lay warm pigeons newly killed to the feet, wrists, or heads of sick persons; & young puppies to their stomachs, & sometimes certain hot gums to their navels; to draw out such vapors or humors as infect the body: for the same reason they hang amulets of arsenick, sublimate, dried toads or spiders, about their patients necks, to draw unto them venomous qualities from their bodies. Hence also it is, that if a man be stricken by a viper or a scorpion, they use to break the body of the beast it self that stung him (if they can get it) upon the wound: but if that beast be crawled out of their finding, they do the like by some other venomous creature; as I have seen a bruised toad laid to the biting of a viper. And they manifestly perceive the applied body, to swell with the poyson sucked out from the wound, and the patient to be relieved and have less poyson; in the same manner as by cupping-glasses, the poyson is likewise drawn out from the wound: so that you may see, the reason of both, is the very same; or at the least very like one another. Onely, we are to note, that the proper body of the beast out of which the venom was driven into the wound, is more efficacious than any other to suck it out.

And the like is to be observed in all other kinds, that such vapors as are to be drawn, do come better and incorporate faster in bodies of like nature, than in those which have onely the common conditions of heat and driness; the one of which serveth to attract; the other to fasten and incorporate into it self the moisture which the first draweth unto it. So we see that water soketh into a dry body, whence it was extracted, almost inseparably, & is hidden in it; as when it raineth first after hot weather, the ground is presently dried after the showre. Likewise we see that

9.
The natural
reason given
for divers ope-
rations, e-
steemed by
some to be ma-
gical.

that in most ciments, you must mingle a dust of the nature of the things we have to be cimented, if you will have them bind strongly.

Out of this discourse, we may yield a reason for those magical operation, which some attribute to the Devils assistance; peradventure because mans wickedness hath been more ingenious than his good will; and so hath found more means to hurt than to help; nay, when he hath arrived some way to help, those very helps have undergone the same calumny; because of the likeness which their operation have to the others. Without doubt very unjustly, if there be truth in the effects. For where have we any such good suggestions of the enemy of mankind proposed unto us, that we may with reason believe he would duly, settledly, and constantly concur to the help and service of all those he so much hateth, as he needs do if he be the Authour of such effects? Or is it not a wrong to Almighty God, and to his carefull instruments; rather to impute unto the Devil the aids which to some may seem supernatural, than unto them of whom we may justly believe and expect such good offices and assistances? I mean, those operations, both good and bad, which ordinarily are called *Magetical*, though peradventure wrongfully, as not having that property which denominateth the loadstone.

One thing I may assure, that if the reports be true, they have the perfect imitation of nature in them. As for example; that the weapons salve, or the sympathetick powder doth require in the using it, to be conserved in an equal and moderate temper: and that the weapon which made the wound, or the cloth upon which the blood remaineth that issued from it, be orderly and frequently dressed; or else the wounded person will not be cured: likewise the steam or spirits, which at the giving of the wound did enter into the pores of the weapon, must not be driven out of it, (which will be done by fire; and so when it is heated by holding over coals, you may see a moisture sweat out of the blade at the opposite side to the fire, as far as it entered into the wounded persons body; which being once all sweated out, you shall see no more the like steam upon the sword) neither must the blood be washed out of the bloody cloth; for in these cases, the powder, or salve, will work nothing. Likewise, if there be any excess either of heat or of cold in keeping the medicated weapon or cloth, the patient feelth that, as he would do, if the like
excess

excess were in any remedy that were applied to the wound it self: likewise if the medicated weapon or bloudy cloth, be kept too close, no effect followeth: likewise, the natures of the things used in these cures are of themselves sovereign for healing the like griefs, though peradventure too violent if they were applyed in body without much attenuation.

And truly if we will deny all effects of this kind, we must in a manner renounce all humane faith: men of all sorts and qualities (and many of them such in my own knowledge, as I cannot question their prudence in observing, or their sincerity in relating) having very frequently made experience of such medicines, and all affirming after one fashion to have found the same effects. Add to these, the multitude of other like effects, appearing or conceited to appear in other things. In some countries it is a familiar disease with kine to have a swelling in the soles of their feet: and the ordinary cure is, to cut a turf upon which they have troden with their sore foot, and to hang it upon a hedg; and as that drieth away, so will their sore amend. In other parts they observe, that if milk newly come from the cow, do in the boiling run over into the fire; and that this do happen often, and neer together to the same cows milk; that cow will have her udder sore and inflamed: and the prevention is to cast salt immediately into the fire upon the milk. The herb *Persicaria* if it be well rubbed upon warts, and then be laid in some fit place to putrifie, causeth the warts to wear away as it rotteth: some say the like of fresh beef. Many examples also there are of hurting living creatures by the like means; which I set not down for fear of doing more harm by the evil inclination of some persons into whose hands they may fall; than profit by their knowing them, unto whom I intend this work.

But to make these operations of nature not incredible; let us remember how we have determined that every body whatsoever doth yield some steam, or vent a kinde of vapour from it self; and consider, how they must needs do so most of all, that are hot and moist, as bloud and milk are, and as all wounds and sores generally are. We see that the foot of a hare or deer leaveth such an impression where the beast hath passed, as a dog can discern it a long time after: and a fox breatheth out so strong a vapor, that the hunters themselves can wind it a great way off,
and

and a good while after he is parted from the place. Now joyn-
ing this, to the experiences we have already allowed of, con-
cerning the attraction of heat; we may conclude, that if any of
these vapors do light upon a solid warm body, which hath the
nature of a source unto them, they will naturally congregate and
incorporate there; and if those vapors be joyned with any medi-
cative quality or body, they will apply that medicament better
than any Chirurgeon can apply it. Then, if the steam of bloud
and spirits, do carry with it from the weapon or cloth, the balsa-
mick qualities of the salve or powder, and with them do settle
upon the wound; what can follow but a bettering in it? Like-
wise, if the steam of the corruption that is upon the clod, do car-
ry the drying quality of the wind which sweepeth over it when
it hangeth high in the air, unto the sore part of the cows foot;
why is it not possible that it should dry the corruption there, as
well as it drieth it upon the hedg? And if the steam of burned
milk can hurt by carrying fire to the dug; why should not salt
cast upon it, be a preservative against it? Or rather, why should
not salt hinder the fire from being carried thither? Since the
nature of salt, alwaies hindereth and suppresseth the activity of
fire: as we see by experience when we throw salt into the fire
below, to hinder the flaming of soot in the top of a chimney:
which presently ceaseth, when new fire from beneath doth not
continue it. And thus we might proceed in sundry other effects,
to declare the reason and the possibility of them; were we cer-
tain of the truth of them: therefore we remit this whole questi-
on, to the authority of the testimonies.

CHAP. XIX.

*Of three other motions belonging to particular bodies, Filtration,
Restitution, and Electrical attraction.*

I. **A**FTER these, let us cast our eye upon another motion, very fa-
miliar among Alchymists; which they call Filtration. It is
effected by putting one end of a tongue, or label of flannen, or
of cotton, or of flax, into a vessel of water, and letting the other
end hang over the brim of it. And it will by little and little
draw all the water out of that vessel (so that the end which hang-
eth out be lower than the superficies of the water) and will make
it all come over into any lower vessel you will receive it in.

The

The end of this operation is, when any water is mingled with gross and muddy parts (not dissolved in the water) to separate the pure & light ones from the impure. By which we are taught, that the lighter parts of the water, are those which most easily do catch. And if we will examine in particular, how it is likely this business passeth; we may conceive that the body or linguet by which the water ascendeth, being a dry one, some lighter parts of the water, whose chance it is to be neer the climbing body of flax, do begin to stick fast unto it: and then, they require nothing neer so great force, nor so much pressing, to make them climb up along the flax, as they would do to make them mount in the pure air. As you may see, if you hold a stick in running water, shelving against the stream: the water will run up along the stick, much higher than it could be forced up in the open air without any support, though the agent were much stronger than the current of the stream. And a ball will upon a rebound, run much higher upon a shelving board, than it would if nothing touched it. And I have been told, that if an egg-shell filled with dew be set at the foot of a hollow stick, the Sun will draw it to the top of the shelving stick, whereas without a prop, it will not stir it.

With much more reason then we may conceive, that water finding as it were little steps in the cotton to facilitate its journey upwards, must ascend more easily than those other things do; so as it once received any impulse to drive it upwards: for the gravity both of that water which is upon the cotton, as also, of so many of the confining parts of water as can reach the cotton, is exceedingly allaid, either by sticking unto the cotton, and so weighing in one bulk with that dry body; or else, by not tending down straight to the center, but resting as it were upon a steep plain (according to what we said of the arm of a syphon that hangeth very sloping out of the water, and therefore draweth not after it a less proportion of water in the other arm that is more in a direct line to the center:) by which means the water as soon as it beginneth to climb, cometh to stand in a kinde of cone; neither breaking from the water below, (its bulk being big enough to reach unto it) nor yet falling down unto it.

But our chief labour must be, to find a cause that may make the water begin to ascend: To which purpose, consider how water

2.

What causeth
the water in
filtration to as-
cend.

of

of its own nature, compresseth it self together, to exclude any other body lighter than it is. Now in respect of the whole mass of the water, those parts which stick to the cotton, are to be accounted much lighter than water; not, because in their own nature they are so; but for the circumstances which accompany them, and do give them a greater disposition to receive a motion upwards than much lighter bodies, whiles they are destitute of such help. Wherefore as the bulk of water weighing and striving downwards; it followeth that if there were any air mingled with it, it would to possess a lesser place, drive out the air: so here in this case, the water that is at the foot of the ladder of cotton, ready to climb with a very small impulse, may be after some sort compared (in respect of the water) to air by reason of the lightness of it: and consequently is forced up by the compressing of the rest of the water round about it. Which no faster getteth up, but other parts at the foot of the ladder do follow the first, and drive them still upwards along the tow; and new ones drive the second, and others the third, and so forth. So that with ease they climb up to the top of the filter, still driving one another forwards, as you may do a fine towel through a musket barrel: which though it be too limber to be thrust straights through; yet cramming still new parts into it at the length you will drive the first quite through.

And thus, when these parts of water are got up to the top of the vessel on which the filter hangeth, and over it on the other side by sticking still to the tow, and by their natural gravity, against which nothing presseth on this side the label; they fall down again by little and little, and by drops break again into water in the vessel set to receive them.

3. But now if you ask, why it will not drop unless the end of the label that hangeth, be lower than the water. I conceive it is because the water which is all along upon the flannel, is one continued body hanging together, as it were a thrid of wire; and is subject to like accidents as such a continued body is. Now suppose you lay a wire upon the edge of the basin, which the filter resteth upon; and so make that edge the center to ballance it upon; if the end that is outermost be heaviest, it will weigh down the other; otherwise, not. So fareth it with this thrid of water: if the end of it that hangeth out of the por, that is to be fitted

Why the filter will not drop unless the label hang lower than the water.

filtered be longer, and consequently heavier, than that which riseth; it must needs raise the other upwards, and fall it self downwards. Now the raising of the other, implieth lifting more water from the cistern, and the sliding of it self farther downwards, is the cause of its converting into drops. So that the water in the cistern serveth like the flax upon a distaff, and is spun into a thrid of water, still as it cometh to the flannen by the drawing it up, occasioned by the overweight of the thrid on the other side of the center.

Which to express better by a similitude in a solid body: I remember I have oftentimes seen in a Mercers shop, a great heap of massie gold lace lie upon their stall; and a little way above it a round smooth pin of wood, over which they use to hale their lace when they wind it into bottoms. Now over this pin, I have put one end of the lace; and as long as it hung no lower than the board upon which the rest of the lace did lie it stirred not; for as the weight of the loose end carried it one way, so the weight of the other side where the whole was, drew it the other way, and in this manner kept it in equilibriety. But as soon as I drew on the hanging end to be heavier than the climbing side (for no more weigheth than is in the air, that which lieth upon the board, having another center) then it began to roul to the ground: and still drew up new parts of that which lay upon the board, until all was tumbled down upon the flore. In the same manner it hapneth to the water, in which, the thrid of it upon the filter is to be compared fitly unto that part of the lace which hung upon the pin; and the whole quantity in the cistern, is like the bulk of lace upon the shopboard; for as fast as the filter draweth it up, it is converted into a thrid like that which is already upon the filter: in like manner as the wheel converteth the flax into yarn, as fast as it draweth it out from the distaff.

Our next consideration will very aptly fall upon the motion of those things, which being bent, do leap with violence to their former figure: whereas others return but a little; and others do stand in that ply, wherein the bending of them hath set them. For finding the reason of which effects, our first reflection may be to note, that a superficies which is more long than broad, containeth a less floor than that whose sides are equal, or nearer being equal: and that of those surfaces whose lines and angles are

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4.
Of the motion
of Restitution:
and why some
bodies stand
bent, others
not.

all equal, that which hath most sides and angles, containeth still the greater floor. Whence it is, that Mathematicians conclude a circle to be the most capacious of all figures: and what they say of lines in respect of a superficies, the same with proportion they say of surfaces in respect of the body contained. And accordingly we see by consequence, that in the making a bag of a long napkin, if the napkin be sewed together long-wise, it holdeth a great deal less than if it be sewed together broad-wise.

By this we see plainly, that if any body which is in a thick and short figure, be forced into a thinner (which by becoming thinner, must likewise become either longer or broader; for what it loseth one way, it must get another) then that superficies must needs be stretched; which in our case, is a physieal outside, or material part of a solid body, not a Mathematical consideration of an indivisible Entity. We see also that this change of figures happeneth in the bending of all those bodies, whereof we are now enquiring the reason why some of them restore themselves to their original figures, and others stand as they are bent.

Then to begin with the latter sort, we find that they are of a moist nature; as among metals, lead, and tin; and among other bodies, those which we account soft. And we may determine, that this effect proceedeth, partly from the humidity of the body that standeth bent; and partly from a dryness peculiar to it, that comprehendeth and fixeth the humidity of it. For by the first, they are rendred capable of being driven into any figure, which nature or art desireth: and by the second, they are preserved from having their gravity put them out of what figure they have once received.

But because these two conditions are common to all solid bodies, we may conclude, that if no other circumstance concurred, the effect arising out of them would likewise be common to all such: and therefore, where we finde it otherwise, we must seek farther for a cause of that transgression. As for example, if you bend the bodies of young trees, or the branches of others, they will return to their due figure. It is true, they will sometimes lean towards that way they have been bent: as may be seen even in great trees after violent tempests; and generally the heads of trees, and the ears of corn, and the grown hedgerows will all bend one way in some Countreys, where some one wind hath a
main

main predominance, and reigneth most continually, as near the sea-shore upon the western coast of *England* (where the south-west wind bloweth constantly the greatest part of the year) may be observed: but this effect proceeding from a particular and extraordinary cause, concerneth not our matter in hand.

We are to examine the reason of the motion of Restitution, which we generally see in young trees, and branches of others, as we said before. In such, we see that the earthy part which maketh them stiff (or rather stark) aboundeth more in them, than in the others that stand as they are bent: at the least in proportion to their natures; but I conceive this is not the cause of the effect we enquire about; but that it is a subtil spirit which hath a great proportion of fire in it. For as in rarefaction, we found that fire, which was either within or without the body to be rarified, did cause the rarefaction, either by entring into it, or by working within it: so seeing here the question is, for a body to go out of a lesser superficies into a greater (which is the progress of rarefaction; and hapneth in the motion of restitution;) the work must needs be done by the force of heat. And because this effect proceedeth evidently, out of the nature of the thing in which it is wrought, and not from any outward cause, we may conclude it hath its origine from a heat that is within the thing it self, or else that was in it, and may be pressed to the outward parts of it, and would sink into it again.

As for example, when a young tree is bended; both every mans conceit is, and the nature of the thing maketh us believe, that the force which bringeth the tree back again to its figure, cometh from the inner side that is bent; which is compressed together, as being shrunk into a circular figure from a straight one: for when solid bodies that were plain on both sides, are bent so as on each side to make a portion of a circle, the convex superficies will be longer than it was before, when it was plain, but the concave will be shorter. And therefore we may conceive, that the spirits which are in the contracted part, (being there squeezed into less room than their nature well brooketh) do work themselves into a greater space; or else that the spirits which are crushed out of the convex side by the extension of it, but do remain besieging it, and do strive to get in again, (in such manner as we have declared when we spoke of attraction, wherein we shewed

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how the emitted spirits of any body will move to their own source, and settle again in it, if they be within a convenient compass;) and accordingly do bring back the extended parts to their former situation; or rather, that both these causes do in their kinds concur to drive the tree into its natural figure.

5. But as we see when a stick is broken, it is very hard to replace all the splinters, every one in its proper situation; so it must of necessity fall out in this bending, that certain insensible parts both inward and outward, are thereby displaced, and can hardly be perfectly rejoynted. Whence it followeth, that as you see the splinters of a half-broken stick, meeting with one another, do hold the stick somewhat crooked; so these invisible parts do the like in such bodies, as after bending stand a little that way. But because they are very little ones, the tree or the branch that hath been never so much bended, may (so nothing be broken in it) be set straight again by pains, without any notable detriment of its strength. And thus you see the reason of some bodies returning in part to their natural figure, after the force leaveth them, that did bend them.

why some bodies return onely in part to their natural figure; others entirely.

Out of which you may proceed to those bodies that restore themselves entirely: whereof steel is the most eminent. And of it, we know that there is a fiery spirit in it, which may be extracted out of it, not onely by the long operations of calcining, digesting and distilling it; but even by gross heating it, and then extinguishing it in wine and other convenient liquors, as Physicians use to do. Which is also confirmed by the burning of steel-dust in the flame of a candle, before it hath been thus wrought upon, which afterwards it will not do: whereby we are taught that originally there are store of spirits in steel, till they are sucked out. Being thus assured, that in steel there is such abundance of spirits; and knowing that it is the nature of spirits to give a quick motion; and seeing that duller spirits in trees do make this motion of Restitution; we need seek no farther, what it is that doth it in steel, or in any other things that have the like nature: which through the multitude of spirits that abound in them (especially steel) do return back with so strong a jerk, that their whole body will tremble a great while after, by the force of its own motion.

6. Concerning the nature of

By what is said, the nature of those bodies which do shrink and stretch, may easily be understood: for they are generally composed

posed of stringy parts, unto which, if humidity happen to arrive, they grow thereby thicker and shorter. As we see that drops of water getting into a new rope of a well, or into a new cable, will swell it much thicker, and by consequence make it shorter.

Galileus noteth such wetting to be of so great efficacy, that it will shrink a new cable, and shorten it notably; notwithstanding the violence of a tempest, and the weight and jerks of a laden ship, do strain it what is possible for them to stretch it. Of this nature leather seemeth to be, and parchment, and divers other things, which if they be proportionably moistened, (and no exteriour force be applyed to extend them) will shrink up; but if they be overwetted, they will become flaccid. Again, if they be suddenly dried, they will shrivel up; but if they be fairly dried after moderate wetting, they will extend themselves again to their first length.

The way having been opened by what we have discoursed before we came to the motion of Restitution, towards the discovery of the manner how heavy bodies may be forced upwards contrary to their natural motion, by very small means in outward appearance; let us now examine (upon the same grounds) if like motions to this of water, may not be done in some other bodies in a subtiler manner. In which, more or less needeth not trouble us; since we know, that neither quantity nor the operations of it do consist in an indivisible, or are limited to determined periods they may not pass. It is enough for us to find a ground for the possibility of the operation: and then the perfecting of it and the reducing of it to such a height as at the first might seem impossible and incredible, we may leave to the oeconomy of wise nature. He that learneth to reade, write, or to play on the lute, is in the beginning ready to lose heart at every step; when he considereth with what labour, difficulty, and slowness he joyneth the letters, spelleth syllables, formeth characters, fitteth and breaketh his fingers (as though they were upon the rack) to stop the right frets, and to touch the right strings. And yet you see how strange a dexterity is gained in all these by industry and practice, and a readines beyond what we could imagine possible, if we saw not daily the effects.

If then we can but arrive to decipher the first characters of the hidden alphabet we are now taing in hand, and can but spel-

lingly read the first syllables of it; we need not doubt, but that the wise Authour of nature in the masterpiece of the creature (which was to express the excellency of the workman) would with excellent cunning and art dispose all circumstances so aptly, as to speak readily a complete language rising from those Elements; and that should have as large an extent in practise and expression, beyond those first principles, which we like children onely lisp out; as the vast discourses of wisest and most learned men are beyond the spellings of infants: and yet those discourses spring from the same root, as the others spellings do, and are but a raising of them to a greater height; as the admired musick of the best player of a lute or harp, that ever was, is derived from the harsh twangs of coarse bowstrings, which are composed together and refined, till at length they arrive to that wonderfull perfection. And so without scruple, we may in the business we are next falling upon, conclude, that the admirable and almost miraculous effects we see, are but the elevating to a wonderfull height those very actions and motions which we shall produce as causes and principles of them.

8.
Concerning
Electrical at-
t action.

Let us then suppose, that there is a solid hard body, of an unchangeable nature; whose parts are so subtile and fiery, that with a little agitation they are much rarified, and do breath out in steams, (though they be too subtile for our eyes to discern) like unto the steame that issueth from sweating men or horses, or like the steam that flyeth from a candle when it is put out: but that these steams, as soon as they come into the cold air, are by that cold suddenly condensed again; and by being condensed, do shorten themselves, and by little and little do retire, till they settle themselves upon the body from whence they sprung: in such manner as you may observe, the little tender horns of snails use to shrink back if any thing touch them, till they settle in little lumps upon their heads. If I say these strings of bituminous vapor should in their way outwards meet with any light and spungie body, they would pierce into it, and settle in it; and if it were of a competent bigness for them to wield, they would carry it with them which way soever they go; so that if they shrink back again to the fountain from whence they came, they must needs carry back with them the light spungie body they have fixed their darts in.

Consider then, that how much heat rarifieth, so much cold condenseth:

condenseth : and therefore such parts as by agitation were spun out into a subtile thrid of an inch long for example, as they cool, do grow bigger and bigger, and consequently shorter and shorter, till at length, they gather themselves back into their main body; and there they settle again in cold bitumen as they were at the first; and the light body that they stick unto, is drawn back with them, and consequently sticketh to the superficies of the bitumen. As if something were tyed at one end of a lute string extended to its utmost capacity, and the other end were fastened to some pin; as the string shrinketh up, so that which is tyed at it, must needs move nearer and nearer the pin: which artifice of nature jugglers do imitate, when by means of an unseen hair, they draw light bodies to them. Now if all this operation be done, without your seeing the little thrids which cause it; the matter appears wonderfull and strange. But when you consider this progress that we have set down, you will judge it possible.

And this seemeth to be the case of those bodies which we call Electrical; as yellow amber, jet, and the like. All which, are of a bituminous unctuous nature, as appeareth by their easie combustibility and smel, when they are burned. And if some do not so apparently shew this unctuous nature, it is because either they are too hard, or else they have a high degree of aqueous humidity joyned with their unctuousity: and in them the operation will be duller in that proportion; for as we see that unctuous substances are more odoriferous than others, and do send their steams farther off, and more efficaciously; so we cannot doubt but that such bodies as consist in a moist nature do accordingly send forth their emanations in a feebler proportion. Yet that proportion will not be so feeble, but that they may have an Electrical effect, as well as the more efficacious Electrical bodies, which may be perceptible, if exact experience be made by an instrument like the mariners needle; as our learned country-man *D. Gilbert* teacheth.

But that in those eminent agents, the spirits, whereby they attract, are unctuous, is plain, because the fire consumeth them; and so if the agents be overheated they cannot work; but moderate heat even of fire increaseth their operation. Again, they are clogged by misty air, or by wetting: and likewise, are pierced through and cut a sunder by spirit of wine or *aqua ardentis*; but oyl doth not hurt them. Likewise, they yield more spirits in

the sun than in the shade ; and they continue longer, when the air is cleared by North or by Eastern winds. They require to be polished, either because the rubbing which polisheth them, doth take off from their surfaces the former emanations, which returning back do stick upon them, and so do hinder the passage of those that are within; or else, because their outsides may be foul; or lastly, because the pores may be dilated by that smoothing. Now that hardness and solidity is required, doth argue that these spirits must be quick ones, that they may return smartly, and not be lost through their languishing in the air. Likewise, that all bodies which are not either exceeding rare, or else set one fire, may be drawn by these unctuous thrids; concludeth that the quality by which they do it, is a common one that hath no particular contrarieties; such a one as we see is in grease or in pitch to stick to any thing; from which in like manner nothing is exempted but fire and air. And lastly, that they work most efficaciously, when they are heated by rubbing, rather than by fire; sheweth that their spirits are excited by motion, and are thereby made to fly abroad; in such manner as we see in pomanders, and in other perfumes, which must be heated if you will have them communicate their sent: and alike effect as in them, agitation doth in jets, yellow amber, and such other Electrical bodies; for if upon rubbing them, you put them presently to your nose, you will discern a strong bituminous smell in them all; which circumstances do shew that this electrical virtue, consists in a certain degree of rarity or density of the bodies unctuous emanations.

Now if these refined and viscous thrids of jet or amber, do in their streaming abroad meet with a piece of straw, or of hay, or of a dried leaf, or some such light and spongie body; it is no marvail if they glew themselves unto it like birdlime; and that in their shrinking back (by being condensed again and repulsed, through the coldness of the air) they carry it along with them to their entire body. Which they that onely see the effect, and cannot penetrate into a possibility of a natural cause thereof, are much troubled withall.

9. *Cabeus* his opinion refuted concerning the cause of Electrical motions

And this seemeth unto me to bear a fairer semblance of truth, than what *Cabeus* delivereth for the cause of Electrical attractions. Whose speculation herein, though I cannot allow for solid, yet I must for ingenious. And certainly even errors are to be commended,

commended; when they are witty ones, and do proceed from a casting farther about than the beaten track of verbal learning, or rather terms which explicate not the nature of the thing in question. He saith, that the coming of straws and such other light bodies unto amber, jet, and the like, proceedeth from a wind raised by the forcible breaking out of subtile emanations from the Electrical bodies into the air, which bringeth those light bodies along with it to the Electrical ones.

But this discourse cannot hold: for first, it is not the nature of unctuous emanations (generally speaking) to cause smart motions singly of themselves. Secondly, although they should raise a wind, I do not comprehend how this wind should drive bodies directly back to the source that raised it; but rather any other way; and so consequently, should drive the light bodies it meeteth with in its way, rather from, than towards the Electrical body. Thirdly, if there should be such a wind raised, and it should bring light bodies to the Electrical ones; yet it could not make them stick thereunto, which we see they do, turn them which way you will, as though they were glewed together.

Neither do his experiences convince any thing; for what he saith that the light bodies are sometimes brought to the Electrical body with such a violence, that they rebound back from it, and then return again to it, maketh rather against him: for if wind were the cause of their motion, they would not return again, after they had leaped back from the Electrical body; no more than we can imagine that the wind it self doth.

The like is of his other experience, when he observed that some little grains of sawdust hanging at an Electrical body, the farthestmost of them not onely fell off, but seemed to be driven away forcibly: for they did not fall directly down, but sideways; and besides did fly away with a violence and smartness that argued some strong impulse. The reason whereof might be that new emanations might smite them, which not sticking and fastening upon them, whereby to draw them nearer, must needs push them farther: or it might be that the emanations unto which they were glewed, shrinking back unto their main body, the later grains were shouldered off by others that already besieged the superficies; & then the emanations retiring swiftly the grains must break off with a force: or else we may conceive it was the force
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of the air that bore them up a little, which made an appearance of their being driven away; as we see feathers and other light things descend not straight down.

CHAP. XX.

Of the Loadstones generation; and its particular motions.

I. **T**Here is yet remaining, the great mystery of the Loadstone to discourse of. Which all Authors, both antient and modern, have agreed upon as an undeniable example and evidence of the shortness of mans reach in comprehending, and of the impossibility of his reason in penetrating into, and explicating such secrets, as nature hath a mind to hide from us. Wherefore our reader (I am sure) will not in this subject expect clear satisfaction or plain demonstration, at our hands: but will judge we have fairly acquitted our selves, if what we say be any whit plausible.

The extreme heat of the sun under the zodiack, draweth a stream of air from each pole into the torrid zone.

Therefore, to use our best indeavours to content him; let us reflect upon the disposition of parts of this habitable globe whereof we are tenants for lives; And we shall find that the sun by his constant course under the zodiack, heateth a great part of it unmeasurably more than he doth the rest. And consequently, that this zodiack being in the midst between two (as it were) ends, which we call the Poles, these poles must necessarily be extremely cold, in respect of the torrid zone; for so we call that part of the earth which lieth under the zodiack.

Nôw looking into the consequence of this; we find that the sun, or the suns heat which reflecteth from the earth in the torrid zone, must rarifie the air extremely, and according to the nature of all heat and fire, must needs carry away from thence, many parts of the air and of the earth sticking to that heat, in such sort as we have formerly declared.

Whence it followeth, that other air must necessarily come from the regions towards both the poles, to supply what is carried away from the middle, as is the course in other fires, and as we have explicated above: especially considering, that the air which cometh from the polewards, is heavier than the air of the torrid zone; and therefore, must naturally press to be still nearer the earth; and so, as it were shouldereth up the air

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of the torrid zone towards the circumference, by rolling into its place: and this, in great quantities; and consequently, the polar air must draw a great train after it.

Which if we consider the great extent of the torrid zone, we shall easily persuade our selves, that it must reach on each side, to the very pole; for taking from *Archimedes*, that the spherical superficies of a portion of a sphere, is to the superficies of the whole sphere, according as the parts of the axis of that sphere comprised within the said portion, is to the whole axis: and considering that (in our case) the part of the axis comprised within the torrid zone, is to the whole axis of the earth, in about the proportion of 4. to 10; it must of necessity follow, that a fire or great heat reigning in so vast an extent, will draw air very powerfully from the rest of the world.

Neither let any man apprehend that this course of the suns elevating so great quantities of atoms in the torrid zone, should hinder the course of gravity there: for first the medium is much rarer in the torrid zone than in the other parts of the earth; and therefore the force of the descending atoms needeth not to be so great there as in other places, to make bodies descend there as fast as they do elsewhere. Secondly, there being a perpetual supply of fresh air from the polar parts, streaming continually into the torrid zone; it must of necessity happen that in the air there come atoms to the torrid zone, of that grossness, that they cannot suddenly be so much rarified as the subtiler parts of air that are there; and therefore, the more those subtiler parts are rarified, and thereby happen to be carried up, the stronger and the thicker the heavier atoms must descend. And thus this concurrence of air from the polar parts, maintaineth gravity under the zodiack; where otherwise all would be turned into fire, and so have no gravity.

Now, who considereth the two hemispheres which by the equator are divided; will find that they are not altogether of equal complexions; but that our hemisphere, in which the North-pole is comprised, is much dryer than the other, by reason of the greater continent of land in this, and the vaster tract of sea in the other; and therefore the supply which cometh from the divers hemispheres, must needs be of different natures; that which cometh from towards the South-pole, being compared to

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The atoms of these two streams coming together are apt to incorporate with one another.

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that which cometh from towards the north, as the more wet to the more dry. Yet of how different complexions soever they be, you see they are the emanations of one and the same body. Not unlike unto what nature hath instituted in the rank of animals: among whom, the male and the female are so distinguished by heat and cold, moisture and drought, that nevertheless all belongeth but to one nature; and that, in degrees though manifestly different, yet so near together, that the body of one is in a manner the same thing, as the body of the other. Even so, the complexions of the two hemispheres are in such sort different in the same qualities, that nevertheless they are of the same nature, and are unequal parts of the same body which we call the earth. Now Alchymists assure us, that if two extractions of one body do meet together, they will incorporate one with the other; especially, if there be some little difference in the complexion of the extractions.

3. Whence it followeth, that these two streams of air, making up one continuat flood of various currents, from one end of the world to the other; each stream that cometh to the equator, from its own Pole, by the extraction of the sun, and that is still supplied with new matter flowing from its own pole to the equator, before the sun can sufficiently rarifie and lift up the atoms that came first perpendicularly under its beams (as it useth to happen in the effects of physical causes, which cannot be rigorously ajusted, but must have some latitude; in which, nature inclineth ever rather to abundance than to defect,) will pass, even to the other pole, by the conduct of his fellow, in case he be by some occasion driven back homewards.

By the meeting and mingling together of these streams at the Equator, divers rivolets of atoms of each pole, are continued from one pole to the other.

For as we see in a boule or paille full of water, or rather in a pipe, through which the water runneth along; if there be a little hole at the bottom or side of it, the water will wriggle and change its course to creep out at that pipe; especially if there be a little spiggot, or quill at the outside of the hole, that by the narrow length of it helpeth in some sort (as it were) to suck it. So if any of the files of the army or flood of atoms sucked from one of the poles to the equator, do there find any gappes, or chinks, or lanes of retiring files in the front of the other poles battalia of atoms, they will press in there: in such manner as we have above declared that water doth by the help of a label

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of cotton; and as is exemplified in all the attractions of venom by venomous bodies, whereof we have given many examples above: and they will go along with them the course they go. For as when a thick short gilded ingot of silver is drawn out into a long subtil wyre; the wyre continuing still perfectly gilded all over, doth manifestly shew that the outside and the inside of the ingot, do strangely meet together, and intermix in the drawing out: so this little stream which (like an eddy current) runneth back from the equator towards its own Pole, will continue to the end still tinged with the mixture of the other Poles atoms, it was incorporated with at his coming to the equator.

Now that some little rivolets of air and atoms should run back to their own Pole, contrary to the course of their main stream, will be easily enough to conceive, if we but consider that at certain times of the year winds do blow more violently and strongly from some determinate part or Romb of the world, than they do at other times, and from other parts. As for example; our *East-India* Mariners tell us of the famous Monsoons they finde in those parts; which are strong winds that reign constantly six moneths of the year from one polewards, and the other six moneths, from the other pole, and begin precisely about the suns entring into such a sign or degree of the zodiack, and continue till about its entrance into the opposite degree. And in our parts of the world, certain smart Easterly or North-easterly winds do reign about the end of March and beginning of April; when it seemeth that some snows are melted by the spring-heats of the sun. And other winds have their courses in other seasons, upon other causes. All which do evidently convince, that the course of the air, and of vapours from the poles to the equator, cannot be so regular and uniform, but that many impediments and crosses do light in the way, to make breaches in it; and thereby to force in it some places to an opposite course. In such sort as we see happeneth in eddy waters, and in the course of a tide, wherein the stream running swiftly in the middle, beateth the edges of the water to the shore, and thereby maketh it run back at the shore. And hence we may conclude, That although the main course of air and atoms (for example, from north to south, in our hemisphere) can never fail of going on towards the equator, constantly at the same

same rate in gross ; nevertheless, in several particular little parts of it (and especially at the edges of those streams that are driven on faster than the rest, by an extraordinary and accidental violent cause) it is variously interrupted, and sometimes entirely stopped, and other times even driven back to the northwards.

And if peradventure any man should think that this will not fall out, because each stream seemeth to be alwaies coming from his own Pole to the equator, and therefore will oppose and drive back any bodies that with less force should strive to swim against it; or if they stick unto them, will carry them back to the equator. We answer, that we must not conceive that the whole air in body doth every where equally inroch from the polewards upon the torrid zone; but, as it were, in certain brooks or rivolets, according as the contingency of all causes put together doth make it fall out.

Now then out of what we have said, it will follow, That since all the air in this our hemisphere, is as it were strewed over and sowed with abundance of northern atoms, and that some brooks of them are in station, others in a motion of retrogradation back to their own north pole; the southern atoms (which coming upon them at the equator, do not onely press in among them, wheresoever they can finde admittance, but do also go on forwards to the north pole in several files by themselves, being driven that way by the same accidental causes, which make the others retire back) seizing in their way upon the northern ones in such manner as we described in filtration; and thereby creeping along by them wheresoever they finde them standing still, and going along with them wheresoever they finde them going back; must of necessity finde passage in great quantities towards, and even to the north pole; though some parts of them will ever and anon be checked in this their journey by the main current prevailing over some accidental one, and so be carried back again to the equator, whose line they had crossed.

And this effect cannot choose but be more or less, according to the seasons of the year: for when the sun is in the Tropick of Capricorn, the southern atoms will flow in much more abundance, and with far greater speed, into the torrid zone, than the northern atoms can; by reason of the suns approximation to the south, and his distance from the north pole; since he

work-

worketh faintest, when he is farthest off: and therefore from the north no more emanations or atoms will be drawn, but such as are most subtilised, and duly prepared for that course. And since onely these selected bands do now march towards the equator, their files must needs be thinner, than when the suns being in the equator or Tropick of Cancer, wakeneth and mustereth up all their forces. And consequently, the quiet parts of air between their files (in which like atoms are also scattered) are the greater: whereby the advenient southern atoms have the larger filter to climb up by. And the like happeneth in the osher hemisphere, when the sun is in the Tropick of Cancer; as who will bestow the pains to compare them, will presently see.

Now then let us consider what these two streams thus incorporated, must of necessity do in the surface or upper parts of the earth. First, it is evident they must needs penetrate a pretty depth into the earth; for so freezing perswadeth us, and much more, the subtil penetration of divers more spiritual bodies, of which we have sufficiently discoursed above. Now let us conceive that these streams do find a body of convenient density to incorporate themselves in, in the way of density, as we see that fire doth in iron, and in other dense bodies: and this not for an hour or two, as happeneth in fire, but for years; as I have been told, that in the extreme cold hills in the Peak in Darbyshire happeneth to the dry atoms of cold, which are permanently incorporated in water by long continual freezing, and so make a kinde of chrystal.

In this case, certainly it must come to pass, that this body will become in a manner wholly of the nature of these steams: which because they are drawn from the Poles that abound in cold and dryness, (for others that have not these qualities, do not contribute to the intended effect) the body is aptest to become a stone: for so we see that cold & drought turneth the superficial parts of the earth into stones & rocks; & accordingly, wheresoever cold & dry winds reign powerfully, all such countreys are mainly rocky.

Now then, let us suppose this stone to be taken out of the earth, and hanged in the air, or set conveniently upon some little pin, or otherwise put in liberty, so as a small impulse may easily turn it any way: it will in this case certainly follow, that the

end

4.

Of these atoms incorporated with some fit matter in the bowels of the earth, is made a stone.

5.

This stone worketh by emanations, joyned with agreeing

streams that
meet them in
the air; and
in fire it is a
load-stone.]

end of the stone, which in the earth lay towards the north pole, will now in the air convert it self in the same manner towards the same point; and the other end which lay towards the south, turn by consequence to the south. I speak of these countreys which lie between the equator and the north; in which it cannot choose but that the stream going from the north to the equator, must be stronger than the opposite one.

Now to explicate how this is done; suppose the stone hanged east and west freely in the air; the stream which is drawn from the north pole of the earth rangeth along by it in its course to the equator; and finding in the stone the south stream, (which is grown innate to it) very strong, it must needs incorporate it self with it; and most, by those parts of the stream in the stone which are strongest: which are they that come directly from the North of the stone; by which I mean that part of the stone that lay northward in the earth, and that still looketh to the north pole of the earth now it is in the air. And therefore the great flood of atoms coming from the north pole of the earth, will incorporate it self most strongly, by the north end of the stone with the little flood of southern atoms it findeth in the stone: for that end serveth for the coming out of the southern atoms, and sendeth them abroad; as the south end doth the northern stream, since the streams do come in at one end, and do go out at the opposite end.

From hence we may gather, that this stone will joyn and cleave to its attractive, whensoever it happeneth to be within the sphere of its activity. Besides, if by some accident it should happen that the atoms or streams which are drawn by the sun from the Polewards to the equator, should come stronger from some part of the earth, which is on the side-hand of the Pole, than from the very Pole it self; in this case the stone will turn from the Pole towards that side. Lastly, whatsoever this stone will do towards the Pole of the earth; the very same a lesser stone of the same kind will do towards a greater. And if there be any kind of other substance that hath participation of the nature of this stone, such a substance will behave it self towards this stone, in the same manner, as such a stone behaveth it self towards the earth: all the Phenomens whereof may be the more plainly observed, if the stone be cut into the form of the earth.

And

And thus, we have found a perfect delineation of the loadstone from its causes: for there is no man so ignorant of the nature of a loadstone, but he knoweth that the properties of it are to tend towards the North; to vary sometimes; to joyn with another loadstone; to draw iron unto it; and such like; whose causes you see delivered.

But to come to experimental proofs and observations upon the loadstone, by which it will appear, that these causes are well esteemed and applyed, we must be beholding to that admirable searcher of the nature of the loadstone, Doctour *Gilbert*; by means of whom and of Doctour *Harvey*, our nation may claim even in this latter age, as deserved a crown for solid Philosophical learning, as for many ages together it hath done formerly for acute and subtile speculations in Divinity. But before I fall to particulars, I think it worth warning my Reader, how this great man arrived to discover so much of Magnetical philosophy; that he likewise, if he be desirous to search into nature, may by imitation advance his thoughts and knowledge that way.

6.
A method for making experiences upon any subject.

In short then, all the knowledge he got of this subject, was by forming a little loadstone into the shape of the earth. By which means he compassed a wonderfull designe, which was, to make the whole globe of the earth maniable: for he found the properties of the whole earth, in that little body; which he therefore called a *Terrella*, or little earth; and which he could manage and try experiences upon, at his will. And in like manner, any man that hath an aim to advance much in natural sciences, must endeavor to draw the matter he inquireth of, into some small model, or into some kind of manageable method; which he may turn and wind as he pleaseth. And then let him be sure, if he hath a competent understanding, that he will not miss of his mark.

But to our intent; the first thing we are to prove is, that the loadstone is generated in such sort as we have described; for proof whereof, the first ground we will lay shall be to consider how in divers other effects it is manifest, that the differences of being exposed to the north or to the south, do cause very great variety in the same thing: as hereafter, we shall have occasion to touch in the barks and grains of trees, and the like. Next, we find by experience, that this virtue of the loadstone is received

7.

The loadstones generation by atoms flowing from both poles, is confirmed by experiments observed in the stone it self.

P

into

into other bodies that resemble its nature, by heatings and coolings: for so it passeth in iron bars, which being thoroughly heated, and then laid to cool north and south, are thereby imbued with a Magnetick virtue; heat opening their bodies, and disposing them to suck in such atoms as are convenient to their nature, that flow unto them whiles they are cooling. So that we cannot doubt, but that convenient matter fermenting in its warm bed under the earth, becommeth a loadstone by the like sucking in of affluent streams of a like complexion to the former.

And it fareth in like manner with those fiery instruments (as fire forks, tongues, shovels, and the like) which do stand constantly upwards and downwards; for they, by being often heated and cooled again, do gain a very strong verticity, or turning to the pole: and indeed, they cannot stand upwards and downwards so little a while, but that they will in that short space gain a manifest verticity; and change it at every turning. Now since the force and vigour of this verticity, is in the end that standeth downwards; it is evident that this effect proceedeth out of an influence received from the earth.

And because in a loadstone (made into a globe, or considered so, to the end you may reckon hemispheres in it, as in the great earth) either hemisphere giveth unto a needle touched upon it, not onely the virtue of that hemisphere, where it is touched, but likewise the virtue of the contrary himisphere; we may boldly conclude, that the virtue which a loadstone is impregnated with in the womb or bed of the earth, where it is formed and groweth, proceedeth as well from the contrary hemisphere of the earth, as from that wherein it lyeth; in such sort, as we have above described. And as we feel oftentimes in our own bodies, that some cold we catch remaineth in us a long while after the taking it, and that sometimes it seemeth even to change the nature of some part of our body into which it is chiefly entered, and hath taken particular possession of; so that whensoever new atoms of the like nature, do again range about in the circumstant air, that part so deeply affected with the former ones of kin to these, doth in a particular manner seem to risent them, and to attract them to it, and to have its guests within it (as it were) awakened and roused up by the strokes of the adventitious ones that knock at their dores. Even so (but much more strongly

strongly, by reason of the longer time and less hinderances) we may conceive that the two virtues or atoms proceeding from the two different hemispheres, do constitute a certain permanent and constant nature in the stone that imbibeth them: which then, we call a loadstone; and is exceeding sensible (as we shall hereafter declare) of the advenience to it of new atoms, alike in nature and complexion to those that it is impregnated with.

And this virtue, consisting in a kind of softer and tenderer substance than the rest of the stone, becometh thereby subject to be consumed by fire. From whence we may gather the reason why a loadstone never recovereth its magnetick virtue, after it hath once lost it; though iron doth; for the humidity of iron is inseparable from its substance, but the humidity of a loadstone, which maketh it capable of this effect, may be quite consumed by fire; and so the stone may be left too dry, for ever being capable of imbibing any new influence from the earth, unless it be by a kind of new making it.

In the next place we are to prove that the loadstone doth work in that manner as we have shewed; for which end let us consider how the atoms that are drawn from each pole and hemisphere of the earth to the equator, making up their course by a manuduction of one another, the hindermost cannot choose but still follow on after the foremost. And as it happeneth in filtration by a cotten cloth; if some one part of the cotten, have its disposition to the ascent of the water, more perfect and ready than the other parts have; the water will assuredly ascend faster in that part, than in any of the rest: so, if the atoms do find a greater disposition for their passage, in any one part of the medium they range through, than in any other, they will certainly not fail of taking that way, in greater abundance, and with more vigour and strength, than any other.

But it is evident, that when they meet with such a stone as we have described, the helps by which they advance in their journey are notably encreased by the flood of atoms which they meet coming out of that stone; which being of the nature of their opposite pole, they seize greedily upon them, and thereby do pluck themselves faster on: like a ferryman that draweth on his boat the swiftest, the more vigorously he tugeth and pulleth at the rope that lyeth thwart the river for him to hale himself

8.

Experiments
to prove that
the loadstone
worketh by
emanations
meeting with
agreeing
streams.

to end in lines
almost parallel
to the axis.

properly it is the whole body of the stone as streaming in lines almost parallel to the axis, from the farthest end, to the other end which is next to the iron: and (in our case) it is that part of the stone which beginneth from the contrary pole and reacheth to the needle. For besides the light which this discourse gave us, experience assureth us that a loadstone, whose poles lie broad-ways, not long-ways, the stone is more imperfect, and draweth more weakly than if the poles lay long-ways; which would not be if the fluours did stream from all parts of the stone directly to the pole: for then, howsoever the stone were cast, the whole virtue of it would be in the poles. Moreover, if a needie were drawn freely upon the same meridian from one pole to the other as soon as it were passed the equator, it would leap suddenly at the very first remove of the equator, where it is parrallel with the axis of the load-stone, from being so parallel, to make an angle with the axis greater than a half right one, to the end that it might look upon the pole which is supposed to be the onely attractive that draweth the needle: which great change wrought all at once, nature never causeth nor admitteth, but in all actions or motions, useth to pass through all the mediums whensoever it goeth from one extreme to another. Besides, there would be no variation of the needles aspect towards the north end of the stone: for if every part did send its virtue immediately to the poles, it were impossible that any other part whatsoever should be stronger than the polar part, seeing that the polar part had the virtue even of that particular part, and of all the other parts of the stone besides, joyned in it self.

This therefore is evident, that the virtue of the loadstone goeth from end to end in parallel lines; unless it be in such stones as have their polar parts narrower than the rest of the body of the stone: for in them, the stream will tend with some little declination towards the pole, as it were by way of refraction; because without the stone, the fluours from the pole of the earth do coarct themselves, and do so thicken their stream, to croud into the stone as soon as they are sensible of any emanations from it, that being (as we have said before) their readiest way to pass along: and within the stone, the stream doth the like to meet the adventent stream where it is strongest and thickest; which is, at that narrow part of the stones end, which is most prominent out.

And

And by this discourse we discover likewise another error of them that imagine the loadstone hath a sphere of activity round about it, equal on all sides; that is, perfectly spherical, if the stone be spherical. Which clearly is a mistaken speculation: for nature having so ordered all her agents, that where the strength is greatest, there the action must (generally speaking) extend it self farthest off; and it being acknowledged that the loadstone hath greatest strength in its poles, and least in the equator; it must of necessity follow, that it worketh farther by its poles, than by its equator. And consequently it is impossible that its sphere of activity should be perfectly spherical.

Nor doth *Cabeus* his experience move us to conceive the loadstone hath a greater strength to retain an iron laid upon it by its equator, than by its poles: for to justify his assertion, he should have tried it in an iron wire that were so short as the poles could not have any notable operation upon the ends of it; since otherwise, the force of retaining it will be attributed to the poles (according to what we have above delivered) and not to the equator.

The eighth position is, that the intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive, and the attracted bodies. Which is evident out of the sticking of them together: as also out of the violence wherewith iron cometh to a loadstone; which when it is drawn by a powerful one, is so great, that through the force of the blow hitting the stone, it will rebound back again, and then fall again to the stone: and in like manner a needle upon a pin, if a loadstone be set near it, turneth with so great a force towards the pole of the stone, that it goeth beyond it, and coming back again, the celerity wherewith it moveth maketh it retire it self too far on the other side; and so by many undulations, at the last it cometh to rest directly opposite to the pole. Likewise, by the declination; by means of which, the iron to the stone, or the stone to the earth, approacheth in such a disposition as is most convenient to joyn the due ends together. And lastly, out of the flying away of the contrary ends from one another: which clearly is to no other purpose, but that the due ends may come together. And in general, there is no doubt but ones going to another, is instituted by the order of nature for their coming together, and for their being together, which is but a perseverance of their coming together.

The

10.

The virtue of the loadstone is not perfectly spherical, though the stone be such.

11.

The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and attracted bodies.

12.

The main
globe of the
earth is not
a loadstone:

The ninth position is, that the nature of a loadstone doth not sink deeply into the main body of the earth, as to have the substance of its whole body be magnetical, but onely remaineth near the surface of it. And this is evident by the inequality in virtue of the two ends; for if this magnetick virtue were the nature of the whole body, both ends would be equally strong. Nor would the disposition of one of the ends be different from the disposition of the other. Again, there could be no variation of the tending towards the north: for the bulk of the whole body would have a strength so eminently greater than the prominences and disparities of hills or seas, as the varieties of these would be absolutely insensible. Again, if the motion of the loadstone came from the body of the earth, it would be perpetually from the center, and not from the poles; and so, there could be no declination more in one part of the earth, than in another. Nor would the loadstone tend from north to south, but from the center to the circumference; or rather from the circumference to the center.

And so we may learn the difference between the loadstone and the earth in their attractive operations; to wit, that the earth doth not receive its influence from another body, nor doth its magnetick virtue depend of another magnetike agent, that impresseth it into it: which nevertheless, is the most remarkable condition of a loadstone. Again, the strongest virtue of the loadstone, is from pole to pole: but the strongest virtue of the earth, is from the center upwards, as appeareth by fire-forks gaining a much greater magnetike strength in a short time, than a loadstone in a longer. Neither can it be thence objected, that the loadstone should therefore receive the earths influences more strongly from the centerwards, than from the poles of the earth, (which by its operation, and what we have discoursed of it, it is certain it doth not;) since the beds where loadstones lie and are formed be towards the bottom of that part or back of the earth which is imbued with magnetike virtue. Again, this virtue which we see in a loadstone, is substantial to it; whereas the like virtue is but accidental to the earth, by means of the suns drawing the northern and southern exhalations to the equator.

13.

The loadstone
is generated in
all parts or cli-
mates of the
earth.

The last position is, that the loadstone must be found over all the earth, and in every country. And so we see it is: both because iron mines are found (in some measure) almost in all countries: &

because,

cause, at the least other sorts of earth (as we have declared of potearths) cannot be wanting in any large extent of country; which when they are baked and cooled in due positions, have this effect of the loadstone, and are of the nature of it. And Doctor Gilbert sheweth, that the loadstone is nothing else but the ore of steel or of perfectest iron; and that it is to be found of all colours, and fashions, and almost of all consistences.

So that we may easily conceive, that the emanations of the loadstone being every where, as well as the causes of gravity; the two motions of magnetick things and of weighty things, do both of them derive their origine from the same source; I mean, from the very same emanations coming from the earth; which by a divers ordination of nature, do make this effect in the loadstone, and that other in weighty things. And who knoweth but that a like sucking to this which we have shewed in magnetick things, passeth also in the motion of gravity? In a word; gravity beareth a fair testimony in the behalf of the magnetick force; and the loadstones working returneth no mean verdict for the causes of gravity, according to what we have delivered of them.

14.
The conformity betwixt the two motions of magnetick things and of heavy things.

CHAP. XXII.

A solution of certain problemes concerning the loadstone, and a short sum of the whole doctrine touching it.

OUT of what is said upon this subject, we may proceed to the solution of certain questions or problemes, which are or may be made in this matter. And first of that which Doctor Gilbert disputeth against all former writers of the loadstone; to wit, which is the North, and which the South pole of a stone? Which seemeth unto me, to be onely a question of the name: for if by the name of north and south, we understand that end of the stone which hath that virtue that the north or south pole of the earth have, then it is certain, that the end of the stone which looketh to the south pole of the earth, is to be called the north pole of the loadstone; and contrariwise, that which looketh to the north, is to be called the south pole of it. But if by the names of north and south pole of the stone, you mean those ends of it, that lie and point to the north and to the south

I.
Which is the North, and which the South pole of a loadstone.

Q

poles

poles of the earth; then you must reckon their poles contrariwise to the former account. So that the terms being once defined, there will remain no farther controversie about the point.

2.
Whether any
bodies besides
magnetick
ones be attra-
ctive.

Doctour Gilbert seemeth also to have another controversie with all writers; to wit, whether any bodies besides magnetical ones be attractive? Which he seemeth to deny; all others to affirm. But this also being fairly put, will peradventure prove no controversie: for the question is either in common, of attraction; or else in particular, of such an attraction as is made by the loadstone. Of the first part, there can be no doubt; as we have declared above; and as is manifest betwixt gold and quicksilver, when a man holding gold in his mouth, it draweth unto it the quicksilver that is in this body. But for the attractive to draw a body unto it self, not wholly, but one determinate part of the body drawn, unto one determinate part of the drawer; is an attraction which for my part I cannot exemplifie in any other bodies but magnetical ones.

3.
Whether an
iron placed
perpendicular-
ly towards the
earth, doth get
a magnetical
virtue of poin-
ting towards
the north, or
towards the
south, in that
end that lieth
downwards.

A third question is, whether an iron that standeth along time unmoved in a window, or any other part of a building; perpendicularly to the earth, doth contract a magnetical virtue of drawing or pointing towards the north in that end which looketh downwards. For *Cabeus* (who wrote since *Gilbert*) affirmeth it out of experience: but either his experiment or his expression was defective. For assuredly if the iron standeth so, in the northern hemisphere, it will turn to the north; and if in the southern hemisphere, it will turn to the south: for seeing the virtue of the loadstone proceedeth from the earth, and that the earth hath different tempers towards the north, and towards the south pole (as hath been already declared) the virtue which cometh out of the earth in the northern hemisphere, will give unto the end of the iron next it an inclination to the north pole; and the earth of the southern hemisphere will yield the contrary disposition unto the end which is nearest it.

4.
Why load-
stones affect
iron better
than one ano-
ther.

The next question is, why a loadstone seemeth to love iron better than it doth another loadstone? The answer is, because iron is indifferent in all its parts to receive the impression of a loadstone; whereas another loadstone receiveth it onely in a determinate part: and therefore a loadstone draweth iron more easily than it can another loadstone; because it findeth repugnance in

in the parts of another loadstone, unless it be exactly situated in a right position. Besides, iron seemeth to be compared to a loadstone, like as a more humid body to a dryer of the same nature; and the difference of male and female sexes in animals do manifestly shew the great appetence of conjunction between moisture and dryness, when they belong to bodies of the same species.

Another question is that great one; why a loadstone capped with steel takes up more iron than it would do if it were without that capping? Another conclusion like unto this, is, that if by a loadstone you take up an iron, and by that iron a second iron, and then you pull away the second iron; the first iron (in some position) will leave the loadstone to stick unto the second iron, as long as the second iron is within the sphere of the loadstones activity; but if you remove the second out of that sphere, then the first iron remaining within it, though the other be out of it, will leave the second, and leap back to the loadstone. To the same purpose, is this other conclusion, That the greater the iron is, which is intirely within the compass of the loadstones virtue, the more strongly the loadstone will be moved unto it, and the more forcibly it will stick to it.

Gilbert's reason refused touching a capped loadstone, that taketh up more iron than one not capped; and an iron impregnated that in some case, draweth more strongly than the stone it self.

The reasons of all these three, we must give at once; for they hang all upon one string. And in my conceit neither *Gilbert* nor *Galileo* have hit upon the right. As for *Gilbert*, he thinketh that in iron there is originally the virtue of the loadstone; but that it is, as it were asleep until by the touch of the loadstone it be awaked and set on work: and therefore the virtue of both joyned together, is greater than the virtue of the loadstone alone.

But if this were the reason, the virtue of the iron would be greater in every regard, and not onely in sticking or in taking up: whereas himself confesseth, that a capped stone draweth no farther than a naked stone, nor hardly so far. Besides, it would continue its virtue out of the sphere of activity of the loadstone, which it doth not. Again, seeing that if you compare them severally, the virtue of the loadstone is greater than the virtue of the iron; why should not the middle iron stick closer to the stone than to the farther iron which must of necessity have less virtue?

Galileo yieldeth the cause of this effect, that when an iron

6.

Q 2.

toucheth

Galileus his opinion touching the former effects refused.

toucheth an iron there are more parts which touch one another, than when a loadstone toucheth the iron: both because the loadstone hath generally much impurity in it, and therefore divers parts of it have no virtue; whereas iron, by being melted hath all its parts pure: and secondly, because iron can be smoothed and polished more than a loadstone can be: and therefore its superficies toucheth in a manner with all its parts; whereas divers parts of the stones superficies cannot touch, by reason of its ruggedness.

And he confirmeth his opinion by experience: for if you put the head of a needle to a bare stone, and the point of it to an iron; and then pluck away the iron; the needle will leave the iron and stick to the stone: but if you turn the needle the other way, it will leave the stone and stick to the iron. Out of which he inferreth that it is the multitude of parts, which causeth the close and strong sticking. And it seemeth he found the same in the capping of his loadstones: for he used flat irons for that purpose; which by their whole plain did take up other irons: whereas *Gilbert* capped his with convex irons; which not applying themselves to other iron, so strongly or with so many parts as *Galileo's* did, would not by much take up so great weights as his.

Nevertheless, it seemeth not to me that his answer is sufficient, or that his reasons convince; for we are to consider that the virtue which he putteth in the iron, must (according to his own supposition) proceed from the loadstone: and then what importeth it, whether the superficies of the iron which toucheth another iron, be so exactly plain or no? Or that the parts of it be more solid than the parts of the stone? For all this conduceth nothing to make the virtue greater than it was: since no more virtue can go from one iron to the other, than goeth from the loadstone to the first iron: and if this virtue cannot tie the first iron to the loadstone, it cannot proceed out of this virtue that the second iron be tied to the first. Again, if a paper be put betwixt the cap and another iron, it doth not hinder the magnetical virtue from passing through it to the iron; but the virtue of taking up more weight than the naked stone was able to do, is thereby rendered quite useless. Therefore it is evident, that this virtue must be put in something else, and not in the application of the magnetical virtue.

And

And to examine his reasons particularly, it may very well fall out that whatsoever the cause be, the point of a needle may be too little to make an exact experience in; & therefore a new doctrine ought not lightly be grounded upon what appeareth in the application of that. And likewise, the greatness of the surfaces of the two irons may be a condition, helpfull to the cause whatsoever it be: for greater and lesser are the common conditions of all bodies, and therefore do avail all kinds of corporeal causes; so that no one cause can be affirmed more than another, meerly out of this, that great doth more, and little doth less.

To come then to our own solution: I have considered how fire hath in a manner the same effect in iron, as the virtue of the loadstone hath by means of the cap: for I finde that fire, coming through iron red glowing hot, will burn more strongly, than if it should come immediately through the air; as also we see that in pitcoal the fire is stronger than in charcole. And nevertheless, the fire will heat farther if it come immediately from the source of it, than if it come through a red iron that burneth more violently where it toucheth; and likewise charcole will heat farther than pitcoal, that neer hand burneth more fiercely. In the same manner, the loadstone will draw farther without a cap than with one; but with a cap it sticketh faster than without one. Whence I see that it is not purely the virtue of the loadstone; but the virtue of it being in iron, which causeth this effect.

Now this modification may proceed either from the multitude of parts which come out of the loadstone, and are as it were stopped in the iron; and so the sphere of their activity becometh shorter, but stronger: or else from some quality of the iron joyned to the influence of the loadstone. The first seemeth not to give a good account of the effect; for why should a little paper take it away, seeing we are sure that it stoppeth not the passage of the loadstones influence? Again, the influence of the loadstone seemeth in its motion to be of the nature of light, which goeth in an insensible time as far as it can reach: and therefore were it multiplied in the iron, it would reach farther than without it; and from it the virtue of the loadstone would begin a new sphere of activity. Therefore we more willingly cleave to the latter part of our determination.

Q 3

And

7.
The Authors
solution to the
former questions.

And thereupon enquiring what quality there is in iron, whence this effect may follow; we finde that it is distinguished from a loadstone, as a metal is from a stone. Now we know that metals have generally more humidity than stones; and we have discoursed above, that humidity is the cause of sticking: especially when it is little and dense. These qualities must needs be in the humidity of iron: which of all metals is the most terrestrial: and such humidity as is able to stick to the influence of the loadstone, as it passeth through the body of the iron, must be exceeding subtil and small; and it seemeth necessary that such humidity should stick to the influence of the loadstone, when it meeteth with it, considering that the influence is of it self dry, and that the nature of iron is a kin to the loadstone: wherefore the humidity of the one, and the drought of the other will not fail of incorporating together. Now then, if two irons well polished and plain, be united by such a glew as resulteth out of this composition, there is a manifest appearance of much reason for them to stick strongly together. This is confirmed by the nature of iron in very cold countreys and very cold weather: for the very humidity of the air in times of frost, will make upon iron, sooner than upon other things, such a sticking glew as will pull off the skin of a mans hand that toucheth it hard.

And by this discourse, you will perceive that *Galileo's* arguments do confirm our opinion as well as his own; and that according to our doctrine, all circumstances must fall out just as they do in his experiences. And the reason is clear why the interposition of another body hindereth the strong sticking of iron to the cap of the loadstone; for it maketh the mediation between them greater, which we have shewed to be the general reason why things are easily parted.

Let us then proceed to the resolution of the other cases proposed. The second is already resolved: for if this glew be made of the influence of the loadstone, it cannot have force farther than the loadstone it self hath: and so far it must have more force than the bare influence of the loadstone. Or rather the humidity of two irons maketh the glew of a fitter temper to hold, than that which is between a dry loadstone and iron; and the glew entereth better when both sides are moist, than when onely one is so.

But

But this resolution though it be in part good, yet it doth not evacuate the whole difficulty, since the same case happeneth between a stronger and a weaker loadstone, as between a loadstone and iron: for the weaker loadstone, whilst it is within the sphere of activity of the greater loadstone, draweth away an iron set betwixt them, as well as a second iron doth. For the reason therefore of the little loadstones drawing away the iron, we may consider that the greater loadstone hath two effects upon the iron, which is betwixt it and a lesser loadstone, and a third effect upon the little loadstone it self. The first is that it impregnateth the iron, and giveth it a permanent vertue by which it worketh like a weak loadstone. The second is, that as it maketh the iron work towards the lesser loadstone by its permanent vertue; so also it accompanieth the steam that goeth from the iron towards the little loadstone with its own steam, which goeth the same way: so that both these steams do in company climb up the steam of the little loadstone which meeteth them; and that steam climbeth up the enlarged one of both theirs together. The third effect which the greater loadstone worketh, is that it maketh the steam of the little loadstone become stronger by augmenting its innate vertue in some degree.

Now then, the going of the iron to either of the loadstones must follow the greater and quicker conjunction of the two meeting steams, and not the greatness of one alone. So that if the conjunction of the two steams between the iron and the little loadstone be greater and quicker than the conjunction of the two steams which meet between the greater loadstone and the iron, the iron must stick to the lesser loadstone. And this must happen more often than otherwise: for the steam which goeth from the iron to the greater loadstone, will for the most part be less than the steam which goeth from the lesser loadstone to the iron. And though the other steam be never so great, yet it cannot draw more than according to the proportion of its Antagonists coming from the iron. Wherefore seeing the two steams betwixt the iron and the little loadstone are more proportionable to one another, and the steam coming out of the little loadstone is notably greater than the steam going from the iron to the greater loadstone; the conjunction must be made for the most part to the little loadstone. And if this discourse doth not hold

8.

The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.

in the former part of the Probleme, betwixt a second iron and a loadstone, it is supplied by the former reason which we gave for that particular purpose.

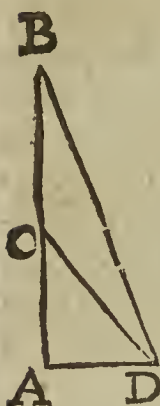
The third case dependeth also of this solution ; for the bigger an iron is, so many more parts it hath to suck up the influence of the loadstone ; and consequently, doth it thereby the more greedily : and therefore the loadstone must be carried to it more violently, and when they are joyned stick more strongly.

9. The sixth question is, Why the variations of the needle from the true north in the northern hemisphere, are greater the neerer you go to the pole, and lesser the neerer you approach to the equator. The reason whereof is plain in our doctrine ; for considering that the magnetick virtue of the earth, streameth from the north towards the equator ; it followeth of necessity, that if there be two streams of magnetick fluours issuing from the north, one of them precisely from the pole, and the other from a part of the earth neer the pole ; and that the stream coming from the point by side the pole, be but a little the stronger of the two ; there will appear very little differences in their severall operations, after they have had a long space to mingle their emanations together ; which thereby do joyn and grow as it were into a stream. Whereas the neerer you come to the pole, the more you will find them severed, and each of them working by its own virtue. And very neer the point which causeth the variation, each stream worketh singly by it self ; and therefore here the point of variation must be master, and will carry the needle strongly unto his course from the due north, if his stream be never so little more efficacious than the other.

Why the variation of a touched needle from the north, is greater, the neerer you go to the pole.

Again, a line drawn from a point of the earth wide of the pole, to a point of the meridian neer the equator, maketh a less angle, than a line drawn from the same point of the earth, to a point of the same meridian neerer the pole : wherefore the variation being esteemed by the quantities of the said angles, it must needs be greater neer the pole, than neer the equator, though the cause be the same.

Which a little figure will presently explicate. Let the point A, be the pole ; and the line A B, the meridian ; and the point B the intersection of it, with a parallel neer the equator ; and the point C the intersection of the Meridian with the Tropick ;



pick; and D, a point in the earth neer the pole, unto which in the said intersection the needle tendeth, in stead of looking directly to the pole, whereby it maketh variation from due north. I say then that the variation of a needle neer the equator in the point B, looking upon the point D, cannot be so great and sensible, as the variation of a needle in the Tropick C, looking upon the same point; since the angle DBA, which is made by the variation of the first, is less than the angle DCA, which is made by the variation of the latter needle, neerer the pole.

But because it may happen, that in the parts neer the equator, the variation may proceed from some piece of land, not much more northerly than where the needle is; but that beareth rather easterly or westerly from it; and yet *Gilberts* assertion goeth universally, when he saith the variations in southern regions are less than in northern ones; we must examine what may be the reason thereof. And presently the generation of the loadstone sheweth it plainly: for seeing the nature of the loadstone proceedeth out of this, that the Sun worketh more upon the Torrid Zone, than upon the poles; and that his too strong operation is contrary to the loadstone, as being of the nature of fire; it followeth evidently, that the lands of the Torrid Zone cannot be so magnetical (generally speaking) as the polar lands are; and by consequence, that a lesser land neer the pole, will have a greater effect, than a larger continent neer the equator: and likewise a land farther off towards the pole, will work more strongly than a nearer land, which lyeth towards the equator.

The seventh question is, Whether in the same part of the world a touched needle may at one time vary more from the true north point, and at another time less? In which *Gilbert* was resolute for the negative part: but our latter Mathematicians are of another mind. Three experiences were made neer *London* in three divers years. The two first 42 years distant from one another; and the third 12 years distant from the second. And by them it is found, that in the space of 54 years, the loadstone hath at *London* diminished his variation from the north, the quantity of 7 degrees and more. But so that in the latter years the diminution hath sensibly gone faster than in the former

10.

Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time less.

Those

These observations peradventure are but little credited by strangers; but we who know the worth of the men that made them, cannot mistrust any notable error in them: for they were very able Mathematicians, and they made their observations with very great exactness; and there were several judicious witnesses at the making of them; as may be seen in Master *Gillebrand* his print concerning this subject. And divers other particular persons do confirm the same; whose credit, though each single might peradventure be slighted, yet all in body make a great accession.

We must therefore cast about to finde what may be the cause of an effect so paradox to the rest of the doctrine of the loadstone: for seeing that no one place can stand otherwise to the north of the earth at one time than another; how is it possible that the needle should receive any new variation, since all variation proceedeth out of the inequality of the earth? But when we consider that this effect proceedeth not out of the main body of the earth, but onely out of the bark of it; and that its bark may have divers tempers not as yet discovered unto us; and that out of the variety of these tempers, the influence of the earthy parts may be divers in respect of one certain place; it is not impossible but that such variation may be, especially in *England*: which Island lying open to the north, by a great and vast Ocean, may receive more particularly than other places the special influences and variation of the weather, that happen in those north-eastern countreys from whence this influence cometh unto us. If therefore there should be any course of weather, whose period were a hundred years (for example) or more or less and so might easily pass unmarked; this variation might grow out of such a course.

But in so obscure a thing, we have already hazarded to guess too much. And upon the whole matter of the loadstone, it serveth our turn, if we have proved (as we conceive we have done fully) that its motions which appear so admirable, do not proceed from an occult quality; but that the causes of them may be reduced unto local motion; and that all they may be performed by such corporeal instruments and means (though peradventure more intricately disposed) as all other effects are among bodies. Whose ordering and disposing and particular progress, there

there is no reason to despair of finding out; would but men carefully apply themselves to that work, upon solid principles and with diligent experiences.

But because this matter hath been very long, and scatteringly diffused in many several branches; peradventure it will not be displeasing to the Reader to see the whole nature of the loadstone summed up in short. Let him then cast his eyes upon one effect of it, that is very easie to be tried, and is acknowledged by all writers; though we have not as yet mentioned it. And it is, that a knife drawn from the pole of a loadstone towards the equator, if you hold the point towards the pole, it gaineth a respect to one of the poles: but contrariwise, if the point of the knife be held towards the equator, and be thrust the same way it was drawn before (that is, towards the equator) it gaineth a respect towards the contrary pole.

II.

The whole doctrine of the loadstone summed up in short.

It is evident out of this experience, that the virtue of the loadstone is communicated by way of streams; and that in it, there are two contrary streams: for otherwise the motion of the knife this way or that way could not change the efficacy of the same parts of the loadstone. It is likewise evident, that these contrary streams do come from the contrary ends of the loadstone. As also that the virtues of them both are in every part of the stone. Likewise that one loadstone must of necessity turn certain parts of it self, to certain parts of another loadstone; nay, that it must go and joyn to it, according to the laws of attraction which we have above delivered: and consequently, that they must turn their disagreeing parts away from one another; and so one loadstone seem to fly from another, if they be so applied that their disagreeing parts be kept still next to one another: for in this case, the disagreeing and the agreeing parts of the same loadstone, being in the same straight line, one loadstone seeking to draw his agreeing part neer to that part of the other loadstone which agreeth with him, must of necessity turn away his disagreeing parts to give way unto his agreeing part to approach neerer.

And thus you see that the flying from one another of two ends of two loadstones, which are both of the same denomination (as for example, the two south ends, or the two north ends) doth not proceed from a pretended antipathy between those

those two ends, but from the attraction of the agreeing ends.

Farthermore, the earth, having to a loadstone the nature of a loadstone; it followeth that a loadstone must necessarily turn itself to the poles of the earth by the same laws. And consequently, must tend to the north, must vary from the north, must incline towards the center, and must be affected with all such accidents as we have deduced of the loadstone.

And lastly, seeing that iron is to a loadstone, a fit matter for it to impress its nature in, and easily retaineth that magnetick virtue; the same effects that follow between two loadstones, must necessarily follow between a loadstone, and a piece of iron finely proportionated in their degrees: excepting some little particularities, which proceed out of the naturalness of the magnetick virtue to a loadstone, more than to iron.

And thus you see the nature of the loadstone summed up in gross; the particular joyns and causes whereof, you may finde treated at large in the main discourse. Wherein we have governed our selves chiefly by the experiences that are recorded by *Gilbert* and *Cabeus*; to whom, we remit our reader for a more ample declaration of particulars.

CHAP. XXIII.

A description of the two sorts of living Creatures; Plants, and Animals: and how they are framed in common to perform vital motion.

I. **H**itherto we have endeavoured to follow by a continual thread, all such effects as we have met with among bodies, and to trace them in all their windings, and to drive them up to their very root and original source: for the nature of our subject having been yet very common, hath not exceeded the compass and power of our search and inquiry, to descend unto the chief circumstances and particulars belonging unto it. And indeed, many of the conveyances whereby the operations we have discoursed of, are performed, be so secret and abstruse, as they that look into them with less heedfulness, and judgement than such a matter requireth, are too apt to impute them to mysterious causes above the reach of human nature to comprehend, and to calumniate them of being wrought by occult and specifick qua-

The connexion of the following Chapters with the precedent ones.

qualities; whereof no more reason could be given, than if the effects were infused by Angelical hands without assistance of inferior bodies, which useth to be the last refuge of ignorant men, who not knowing what to say, and yet presuming to say something, do fall often upon such expressions, as neither themselves nor their hearers understand; and that if they be well scanned, do imply contradictions. Therefore we deemed it a kind of necessity to strain our selves to prosecute most of such effects, even to their notional connexions with rarity and density. And the rather, because it hath not been our luck yet to meet with any that hath had the like design, or hath done any considerable matter to ease our pains. Which cannot but make the readers journey somewhat tedious unto him to follow all our steps, by reason of the ruggedness, and untrodness of the paths we have walked in.

But now the effects we shall henceforward meddle withall, do grow so particular, and do swarm into such a vast multitude of several little joynts, and wreathy labyrinths of nature, as were impossible in so summary a treatise, as we intend, to deliver the causes of every one of them exactly; which would require both large discourses and abundance of experiences to acquit our selves as we ought of such a task. Nor is there a like need of doing it as formerly, for as much as concerneth our design; since the causes of them palpably material, and the admirable artifice of them consisteth onely in the Dædalean and wonderfull ingenious ordering and ranging them one with another.

We shall therefore intreat our Reader from this time forwards to expect onely the common sequels of those particular effects, out of the principles already laid. And when some shall occur, that may peradventure seem at the first sight to be enacted immediately by a vertue spiritual, and that proceedeth indivisibly, in a different strain from the ordinary processes which we see in bodies and in bodily things (that is, by the virtues of rarity and density, working by local motion) we hope he will be satisfied at our hands, if we lay down a method, and trace out a course, whereby such events and operations may follow out of the principles we have laid. Though peradventure we shall not absolutely convince that every effect is done just as we set it down in every particular, and that it may not as well be done by
some

some other disposing of parts under the same general scope: for it is enough for our turn; if we shew that such effects may be performed by corporeal agents, working as other bodies do, without confining our selves to an exactness in every link of the long chain that must be wound up in the performance of them.

2. Concerning several compositions of mixed bodies. To come then to the matter; The next thing we are to employ our selves about, now that we have explicated the nature of those motions by means whereof bodies are made and destroyed; and in which they are to be considered chiefly as passive; while some exterior agent working upon them causeth such alterations in them, and bringeth them to such pass as we see in the changes that are dayly wrought among substances; is to take a survey of those motions which some bodies have, wherein they seem to be not so much patients as agents; and do contain within themselves the principle of their own motion; and have no relation to any outward object, more than to stir up that principle of motion, and set it on work: which when it is once in act, hath as it were within the limits of its own kingdom, and severed from commerce with all other bodies whatsoever, many other subaltern motions over which it presideth.

To which purpose we may consider, that among the compounded bodies whose natures we have explicated, there are some in whom the parts of different complexions are so small and so well mingled together, that they make a compound which to our sense seemeth to be all of it quite through of one homogeneous nature; and howsoever it be divided, each part retaineth the entire and complete nature of the whole. Others again there are, in which it is easie to discern that the whole is made up of several great parts of very differing natures and tempers.

And of these there are two kinds: the one, of such as their differing parts seem to have no relation to one another, or correspondence together to perform any particular work, in which all of them are necessary; but rather they seem to be made what they are by chance and by accident; and if one part be severed from another, each is an entire thing by it self, of the same nature as it was in the whole; and no harmony is destroyed by such division. As may be observed in some bodies digged out of mines, in which one may see lumps of metal, ore, stone, and

and glass, and such different substances, in their several distinct situations, perfectly compacted into one continue body, which if you divide, the glass remaineth what it was before, the Emerald is still an Emerald, the silver is good silver, and the like of the other substances; the causes of which may be easily deduced out of what we have formerly said. But there are other bodies in which this manifest and notable difference of parts, carrieth with it such a subordination of one of them unto another, as we cannot doubt but that nature made such engines (if so I may call them) by design; and intended that this variety should be in one thing; whose unity and being what it is, should depend of the harmony of the several differing parts, and should be destroyed by their separation. As we see in living creatures, whose particular parts and members being once severed, there is no longer a living creature to be found among them.

Now of this kind of bodies there are two sorts. The first is of those that seem to be one continue substance, wherein we may observe one and the same constant progress throughout, from the lowest unto the highest part of it; so that the operation of one part is not at all different from that of another: but the whole body seemeth to be the course and throughfare of one constant action, varying it self in divers occasion and occurrences, according to the disposition of the subject.

3.
Two sorts of living creatures.

The bodies of the second sort, have their parts so notably separated one from the other; and each of them have such a peculiar motion proper unto them; that one might conceive they were every one of them a complete distinct total thing by it self, and that all of them were artificially tied together; were it not that the subordination of these parts to one another is so great, and the correspondence between them so strict, (the one not being able to subsist without the other, from whom he deriveth what is needfull for him: and again, being so usefull unto that other, and having its action and motion so fitting and necessary for it, as without it, that other cannot be:) as plainly convinceth that the compound of all these several parts must needs be one individual thing.

I remember that when I travelled in *Spain*, I saw there two engines that in some sort do express the natures of these two kinds of bodies. The one at *Tolledo*, the other at *Segovia*: both of

4.
An engine to express the first sort of living creatures.

of them set on work by the current of the river, in which the foundation of their machine was laid. That at *Toledo* was to force up water a great height from the river *Tagus* to the *Alcazar* (the kings palace) that standeth upon a high steep hill or rock, almost perpendicular over the river. In the bottom there was an intended wheel, which turning round with the stream, gave motion at the same time to the whole engine; which consisted of a multitude of little troughs or square ladles set one over another in two parallel rows over against one another, from the bottom to the top, and upon two several divided frames of timber. These troughs were closed at one end with a traverse board to retain the water from running out there; which end being bigger than the rest of the trough, made it somewhat like a ladle; and the rest of it seemed to be the handle with a channel in it, the little end of which channel or trough was open to let the water pass freely away. And these troughs were fastened by an axletree in the middle of them, to the frame of timber that went from the bottom up to the top: so that they could upon that center move at liberty, either the shut end downwards, or the open end; like the beam of a balance.

Now at a certain position of the root-wheel (if so I may call it) all one side of the machine sunk down a little lower towards the water, and the other was raised a little higher. Which motion was changed as soon as the ground-wheel had ended the remnant of his revolution: for then the side that was lowest before sprung up, and the other sunk down. And thus the two sides of the machine were like two legs that by turns trod the water; as in the vintage men press grapes in a watt. Now the troughs that were fastened to the timber which descended, turned that part of them downwards which was like a box shut to hold the water: and consequently, the open end was up in the air, like the arm of the balance unto which the lightest scale is fastened: and in the mean time, the troughs upon the ascending timber, were moved by a contrary motion; keeping their box ends aloft, and letting the open ends incline downwards: so that if any water were in them, it would let it run out; whereas the others retaind any that came into them.

When you have made an image of this machine in your phantasie,

phantastic, consider what will follow out of its motion. You will perceive that when one leg sinketh down towards the water, that trough which is next to the superficies of it, putting down his box end, and dipping it a little in the water; must needs bring up as much as it can retain, when that leg ascendeth: wch when it is at its height, the trough moveth upon his own center, and the box end, which was lowest, becometh now highest, and so the water runneth out of it. Now the other leg descending at the same time, it falleth out that the trough on its side, which would be a step above that which hath the water in it, if they stood in equi-librity, becometh now a step lower than it: and is so placed, that the water which runneth out of that which is aloft, falleth into the head or box of it; which no sooner hath received it, but that leg on which it is fastned, springeth up, and the other descendeth: so that the water of the second leg, runneth now into the box of the first leg, that is next above that which first laded the water out of the river. And thus, the troughs of the two legs deliver their water by turns from the one side to the other; and at every remove, it getteth a step upwards, till it commeth to the top; whiles at every ascent and descent of the whole side, the lowest ladle or trough taketh new water from the river: which ladle-full followeth immediately in its ascent, that which was taken up the time before. And thus, in a little while, all the troughs from the bottome to the top are full; unless there happen to be some failing in some ladle: and in that case the water breaketh out there; and all the ladles above that are dry.

The other engine, or rather multitude of several engines, to perform sundry different operations, all conducing to one work (whereas, that of *Toledo*, is but one tenour of motion, from the first to the last;) is in the mint at *Segovia*. Which is so artificially made, that one part of it, distendeth an ingot of silver or gold into that breadth and thickness as is requisite to make coyn of. Which being done, it delivereth the plate it hath wrought, unto another that printeth the figure of the coyn upon it. And from thence it is turned over to another that cutteth it according to the print, into due shape and weight. And lastly, the several pieces fall into a reserve, in another room: where the officer, whose charge it is, findeth treasure ready coined; without any thing there, to informe him of the several

5.

Another engine by which may be expressed the second sort of living creatures.

R.

disse.

different motions that the silver or the gold passed before they came to that state. But if he go on the other side of the wall, into the room where the other machines stand and are at work, he will then discern that every one of them, which considered by it self might seem a distinct complete engine, is but a serving part of the whole; whose office is, to make money: and that for this work, any one of them separated from the rest, ceaseth to be the part of a mint, and the whole is maimed and destroyed.

6. Now let us apply the consideration of these different kinds of engines, to the natures of bodies we treat of. Which I doubt not, would fit much better, were they lively and exactly described. But it is so long since I saw them, and I was then so very young, that I retain but a confused and cloudy remembrance of them: especially of the mint at *Segovia*, in the which there are many more particulars than I have touched; as conveniency for refining the ore or metal; and then casting it into ingots; and driving them into rods, and such like: unto all which, there is little help of hands requisite, more than to apply the matter duly at the first. But what I have said of them, is enough to illustrate what I aim at: and though I should err in the particulars, it is no great matter, for I intend not to deliver the history of them: but onely out of the remembrance of such notefull and artificial masterpieces, to frame a model in their phancies that shall read this, of something like them; whereby they may with more ease, make a right conception of what we are handling.

Thus then; all sorts of plants, both great and small, may be compared to our first ingine of the water work at *Tolledo*, for in them all the motion we can discern, is of one part transmitting unto the next to it, the juice which it received from that immediately before it: so that it hath one constant course from the root (which sucketh it from the earth) unto the top of the highest sprig: in which if it should be intercepted and stopped by any maiming of the bark (the chanel it ascendeth by) it would there break out and turn into drops, or gum, or some such other substance as the nature of the plant requireth; and all that part of it unto which none of this juice can ascend would dry and wither and grow dead.

But sensible living creatures, we may fitly compare to the second machine of the mint at *Segovia*. For in them, though every part

part and member be as it were a complete thing of it self, yet every one requireth to be directed and put on in its motion by another; and they must all of them (though of very different natures and kinds of motion) conspire together to effect any thing that may be for the use and service of the whole. And thus we find in them perfectly the nature of a mover and a moveable; each of them moving differently from one another, and framing to themselves their own motions, in such sort as is most agreeable to their nature, when that part which setteth them on work hath stirred them up.

And now because these parts (the movers and the moved) are parts of one whole; we call the intire thing *automatum*, or *se movens*, or a living creature. Which also may be fitly compared to a joyner, or a painter, or other craftsmen, that had his tools so exactly fitted about him, as when he had occasion to do any thing in his trade, his tool for that action were already in the fittest position for it, to be made use of, so as without removing himself from the place where he might sit invironed with his tools, he might, by onely pulling of some little chords, either apply the matter to any remote toole, or any of his tools to the matter he would work upon, according as he findeth the one or the other more convenient for performance of the action he intendeth.

Whereas in the other, there is no variety of motions; but one and the same goeth quite through the body from one end of it to the other. And the passage of the moisture through it, from one part to another next (which is all the motion it hath) is in a manner but like the rising of water in a Still, which by heat is made to creep up by the sides of the glass; and from thence runneth through the nose of the limbeck, and falleth into the Receiver. So that, if we will say that a plant liveth, or that the whole moveth it self, and every part moveth other; it is to be understood in a far more imperfect manner, than when we speak of an animal: and the same words are attributed to both, in a kind of equivocal sense. But by the way I must note, that under the title of plants I include not zoophytes or plantanimals, that is such creatures as though they go not from place to place, and so cause a local motion of their whole substance, yet in their parts, they have a distinct and articulate motion.

[But to leave comparisons, and come to the proper nature of the things

7
How plants
are framed.

things: let us frame a conception, that not far under the superficies of the earth, there were gathered together divers parts of little mixed bodies, which in the whole sum were yet but little: and that this little mass had some excess of fire in it, such as we see in wet hay, or in muste of wine, or in woort of beer: and that withall the drought of it were in so high a degree, as this heat should not find means (being too much compressed) to play his game: and that, lying there in the bosome of the earth, it should after some little time receive its expected and desired drink through the benevolence of the heaven; by which it being moistened, and thereby made more pliable, and tender and easie to be wrought upon, the little parts of fire should break loose; and they finding this moisture a fit subject to work upon, should drive it into all the parts of the little mass, and digesting it there, should make the mass swell. Which action taking up long time for performance of it, in respect of the small increase of bulk made in the mass by the swelling of it; could not be hindred by the pressing of the earth, though lying never so weightily upon it: according to the maxim we have above delivered, that any little force, be it never so little, is able to overcome any great resistance, be it never so powerfull, if the force do multiply the time it worketh in, sufficiently to equalise the proportions of the agent and the resistant.

This increase of bulk and swelling of the little mass, will of its own nature be towards all be sides, by reason of the fire and heat that occasioneth it (whose motion is on every side, from the center to the circumference:) but it will be most efficacious upwards, towards the air, because the resistance is least that way; both by reason of the little thickness of the earth over it; as also by reason that the upper part of the earth lieth very loose and is exceeding porous, through the continual operation of the sun and falling of rain upon it. It cannot choose therefore but mount to the air; and the same cause that maketh it do so, presseth at the same time the lower parts of the mass, downwards. But what ascendeth to the air, must be of the hotter and more moist parts of the fermenting mass; and what goeth downwards must be of his harder and drier parts proportionate to the contrary motions of fire and of earth, which predominate in these two kinds of parts. Now this that is pushed upwards,
coming

coming above ground, and being there exposed to sun and wind, contracteth thereby a hard and rough skin on its outside, but within is more tender; in this sort it defendeth itself from outward injuries of weather whiles it mounteth: and by thrusting other parts down into the earth, it holdeth it self stedfast, that although the wind may shake it, yet it cannot overthrow it. The greater this plant groweth, the more juyce is daily accrued unto it, and the heat is encreased; and consequently, the greater abundance of humours is continually sent up. Which when it beginneth to clog at the top, new humour pressing upwards, forceth a breach in the skin; and so a new piece, like the main stem, is thrust out, and beginneth on the sides, which we call a branch. Thus is our plant amplified, till nature not being able still to breed such strong issues, falleth to work of less labour, and pusheth forth the most elaborate part of the plants juyce into more tender substances, but especially at the ends of the branches, where abundant humour, but at the first not well concocted, groweth into the shape of a button; and more and better concocted humour succeeding, it groweth softer and softer (the sun drawing the subtilest parts outwards) excepting what the coldness of the air, and the roughness of the wind do harden into an outward skin. So then the next parts to the skin are tender; but the very middle of this button must be hard and dry, by reason that the sun from without, and the natural heat within, drawing and driving out the moisture, and extending it from the center, must needs leave the more earthy parts much shrunk up and hardened by their evaporating out from them: which hardning, being an effect of fire within and without, that basketh this hard substance, incorporateth much of it self with it, as we have formerly declared in the making of salt by force of fire. This button, thus dilated, and brought to this pass, we call the fruit of the plant, whose harder part encloseth oftentimes another not so hard as dry. The reason whereof is, because the outward hardness permitteth no moisture to soak in any abundance through it; and then, that which is enclosed in it, must needs be much dried; though not so much, but that it still retaineth the common nature of the plant. This drought maketh these inner parts to be like a kind of dust; or at the least, such as

may be easily dried into dust, when they are bruised out of the husk that incloseth them. And in every parcel of this dust, the nature of the whole resideth, as it were contracted into a small quantity; for the juyce which was first in the button, and had passed from the root through the manifold varieties of the divers parts of the plant, and had suffered much concoction, partly from the sun, and partly from the inward heat imprisoned in that harder part of the fruit, is by these passages, strainings and concoctions, become at the length to be like a tincture extracted out of the whole plant; and is at the last dried up into a kinde of magistery. This we call the seed: which is of a fit nature, by being buried in the earth, and dissolved with humour, to renew and reciprocate the operation we have thus described. And thus, you have the formation of a plant.

8.

How sensitive
creatures are
formed.

But a sensitive creature, being compared to a plant, as a plant is to a mixed body; you cannot but conceive that he must be compounded as it were of many plants, in like sort as a plant is of many mixed bodies. But so, that all the plants which concur to make one animal, are of one kinde of nature and cognation: and besides, the matter, of which such diversity is to be made, must of necessity be more humid and figurable, than that of an ordinary plant: and the artificer which worketh and mouldeth it, must be more active. Wherefore we must suppose that the mass, of which an animal is to be made, must be actually liquid: and the fire that worketh upon it, must be so powerfull, that of its own nature it may be able to convert this liquid matter into such breaths and steams, as we see do use to rise from water, when the sun or fire worketh upon it. Yet if the mass were altogether as liquid as water, it would vanish away by heat boyling it, and be dried up: therefore it must be of such a convenient temper, that although in some of its parts it be fluid and apt to run, yet by others it must be held together; as we see that unctuous things for the most part are; which will swell by heat, but not flie away.

So then, if we imagine a great heat to be imprisoned in such a liquor; and that it seeketh, by boyling, to break out, but that the solidness and viscuosness of the substance will not permit it to evaporate; it cannot choose but comport it self in some such sort as we see butter or oyl in a frying-pan over the fire, when it

it riseth in bubbles, but much more efficaciously ; for their body is not strong enough to keep in the heat ; and therefore those bubbles fall again ; whereas if it were, those bubbles would rise higher and higher, and stretch themselves longer and longer (as when the soap-boylers do boyl a strong unctuous lye into soap ;) and every one of them would be as it were a little brook, whereof the channel would be the enclosing substance ; and the inward smoke that extendeth it, might be compared to the water of it : as when a glass is blown out by fire and air into a long figure.

Now we may remember, how we have said, where we treated of the production and resolution of mixed bodies, that there are two sorts of liquid substantial parts, which by the operation of fire are sent out of the body it worketh upon ; the watery, and the oily parts. For though there appear sometimes some very subtil and ethereal parts of a third kind (which are the *aque ardentes*, or burning spirits ;) yet in such a close distilling of circulation as this is, they are not severed by themselves, but do accompany the rest ; and especially the watery parts, which are of a nature, that the rising ethereal spirits easily mingle with, and extend themselves in it ; whereby the water becometh more efficacious, and the spirits less fugitive.

Of these liquid parts which the fire sendeth away, the watery ones are the first, as being the easiest to be raised : the oily parts rise more difficultly, and therefore do come last. And in the same manner it happeneth in this emission of brooks, the watery and oily streams will each of them flie into different reserves : and if there arrive unto them abundance of their own quality, each of them must make a substance of its own nature, by settling in a convenient place, and by due concoction. Which substance after it is made and confirmed, if more humidity and heat do press it, will again break forth into other little channels. But when the watery and oily parts are boiled away, there remain yet behind other more solid and fixed parts, and more strongly incorporated with fire than either of these : which yet cannot dry up into a fiery salt, because a continual accession of humour keepeth them alwaies flowing : and so they become like a cauldron of boyling fire. Which must propagate it self as wide as either of the others ; since the

activity of it must needs be greater than theirs (as being the source of motion unto them) and that there wanteth not humidity for it to extend it self by.

And thus you see three roots of three divers plants, all in the same plant, proceeding by natural resolution from one primitive source. Whereof that which is most watry, is fittest to fabricate the body and common outside of the triformed plant; since water is the most figurable principle that is in nature, and the most susceptible of multiplication; and by its cold is easiest to be hardened, and therefore fittest to resist the injuries of enemy-bodies that may infest it. The oily parts are fittest for the continuance and solidity of the plant: for we see that viscuosity and oilyness hold together the parts where they abound; and they are slowly wasted by fire, but do conserve, and are an aliment to the fire that consumeth them. The parts of the third kinde are fittest for the conservation of heat: which though in them it be too violent, yet it is necessary for working upon other parts, and for maintaining a due temper in them.

And thus we have armed our plant with three sorts of rivers or brooks to run through him, with as many different streams; the one of a gentle balsamike oyl; another, of streaming fire; and the third, of a connatural and cooler water to irrigate and temper him. The streams of water, (as we have said) must run through the whole fabrick of this triformed plant: and because it is not a simple water, but warm in a good degree, and as it were a middle substance betwixt water and air (by reason of the ardent volatile spirit that is with it) it is of a fit nature to swell, as air doth; and yet withall to resist violence in a convenient degree, as water doth. Therefore if from its source nature sendeth abundance into any one part; that part must swell and grow thicker and shorter; and so must be contracted that way which nature hath ordered it. Whence we perceive a means by which nature may draw any part of the outward fabrick, which way soever she is pleased, by set instruments for such an effect. But when there is no motion, or but little in these pipes, the standing stream that is in a very little, though long chanel, must needs be troubled in its whole body, if any one part of it be pressed upon, so as to receive thereby any impression: and therefore

fore whatsoever is done upon it, though at the very farthest end of it, maketh a commotion, and sendeth an impression up to its very source. Which appearing by our former discourse to be the origine of particular and occasional motions; it is obvious to conceive how it is apt to be moved and wrought by such an impression to set on foot the beginning of any motion; which by natures providence is convenient for the plant, when such an impression is made upon it.

And thus you see this plant hath the virtue both of sense or feeling; that is, of being moved and affected by extern objects, lightly striking upon it; as also of moving it self, to or from such an object; according as nature shall have ordained. Which in sum is, That this plant is a sensitive creature, composed of three sources, the heart, the brain, and the liver: whose offsprings are the arteries, the nerves, and the veins; which are filled with vital spirits, with animal spirits, and with blood: and by these the animal is heated, nourished, and made partaker of sense and motion.

Now referring the particular motion of living creatures, to another time: we may observe, that both kinds of them, as well vegetables as animals, do agree in the nature of sustaining themselves in the three common actions of generation, nutrition, and augmentation; which are, the beginning, the progress, and the conserving of life. Unto which three we may add, the not so much action as passion of death, and of sickness or decay, which is the way to death.

C H A P. XXIV.

A more particular survey of the generation of Animals, in which is discovered what part of the Animal is first generated.

TO begin then with examining how living creatures are ingendered: our main question shall be, Whether they be framed entirely at once; or successively, one part after another? And if this latter way, which part first? Upon the discussion of which, all that concerneth generation will be explicated, as much as concerneth our purpose in hand. To reduce this from its origine, we may remember how our Masters tell us, that when any living creature is passed the heat of its augmentation or grow-

I.
The opinion,
That the seed
containeth
formally every
part of the
parent.

growing: the superfluous nourishment settleth it self in some appointed place of the body to serve for the production of some other. Now it is evident, that this superfluity cometh from all parts of the body, and may be said to contain in it after some sort the perfection of the whole living creature. Be it how it will, it is manifest that the living creature is made of this superfluous moisture of the parent: which, according to the opinion of some, being compounded of several parts derived from the several limbs of the parent; those parts when they come to be fermented in convenient heat and moisture, do take their posture and situation, according to the posture and disposition of parts that the living creature had from whence they issued: and then they growing daily greater and solidier, (the effects of moisture and of heat;) do at the length become such a creature as that was, from whence they had their origine.

Which an accident that I remember, seemeth much to confirm. It was of a cat that had its tail cut off when it was very young: which cat happening afterwards to have young ones, half the kitlings proved without tails, and the other half had them in an ordinary manner; as if nature could supply but one partners side, not on both. And another particular that I saw when I was at *Argiers*, maketh to this purpose, which was of a woman, that having two thumbs upon the left hand; four daughters that she had did all resemble her in the same accident, and so did a little child, a girl of her eldest daughters; but none of her sons. Whiles I was there, I had a particular curiosity to see them all: and though it be not easily permitted unto Christians to speak familiarly with Mahometan women; yet the condition I was in there, and the civility of the Bassha, gave me the opportunity of full view and discourse with them: and the old woman told me, that her mother and grandmother had been in the same manner. But for them, it resteth upon her credit; the others I saw my self.

2.
The former
opinion re-
jected.

But the opinion which these accidents seem to support, though at the first view it seemeth smoothly to satisfy our inquiry, and fairly to compass the making of a living creature: yet looking farther into it, we shall find it fall exceeding short of its promising; and meet with such difficulties, as it cannot overcome. For first, let us cast about how this compound of several parts, that
serves

serves for the generation of a new living creature, can be gathered from every part and member of the parent; so to carry with it in little the compleat nature of it. The meaning hereof must be, that this superfluous aliment, either passeth through all and every little part and particle of the parents body, and in its passage receiveth something from them: or else, that it receiveth onely from all similar and great parts.

The former seemeth impossible; for how can one imagine that such juyce should circulate the whole body of an animal, and visit every atom of it, and retire to the reserve where it is kept for generation; and no part of it remain absolutely behind, sticking to the flesh or bones that it bedeweth; but that still some part returneth back from every part of the animal? Besides, consider how those parts that are most remote from the channels which convey this juyce; when they are fuller of nourishment than they need, the juyce which overfloweth from them, cometh to the next part, and settling there, and serving it for its due nourishment, driveth back into the channel, that which was betwixt the channel and it self; so that here there is no return at all from some of the remote parts; and much of that juyce which is rejected, never went far from the channel it self. We may therefore safely conclude, That it is impossible every little part of the whole body should remit something impregnated and imbued with the nature of it.

But then you may peradventure say, That every similar part doth. If so, I would ask, How it is possible that by fermentation onely, every part should regularly go to a determinate place, to make that kind of animal in which every similar part is diffused to so great an extent? How should the nature of flesh here become broad, there round, and take just the figure of the part it is to cover? How should a bone here be hollow, there be blady, and in another part take the form of a rib, and those many figures which we see of bones? And the like we might ask of every other similar part, as of the veins and the rest. Again, seeing it must of necessity happen, that at one time more is remitted from one part than from another; how cometh it to pass, that in the collection the due proportion of nature is so punctually observed? Shall we say, that this is done by some cunning artificer, whose work it is to set all these parts in their due posture; which

Aristotle

Aristotle attributeth to the seed of the male? But this is impossible; for all this diversity of work is to be done at one time, and in the same occasion: which can no more be effected by one agent, than multiplicity can immediately proceed from unity.

But besides that there can be no agent to dispose of the parts when they are gathered; it is evident that a sensitive creature may be made without any such gathering of parts beforehand from another of the same kind: for else, how could vermine breed out of living bodies, or out of corruption? How could rats come to fill ships, into which never any were brought? How could frogs be ingendred in the air? Eels of dewy turfs, or of mud? Toads of Ducks? Fish of Herbs? And the like. To the same purpose, when one species or kind of animal is changed into another; as when a caterpillar or a silk-worm becometh a flie; it is manifest that there can be no such precedent collection of parts.

3.
The Authours
opinion of this
question.

And therefore there is no remedy but we must seek out some other means and course of generation, than this. Unto which we may be lead, by considering how a living creature is nourished and augmented: for why should not the parts be made in generation of a matter like to that which maketh them in nutrition? If they be augmented by one kind of juyce that after several changes turneth at the length into flesh and bone, and into every sort of mixed body or similar part, whereof the sensitive creature is compounded, and that joyneth it self to what it findeth already made, why should not the same juyce with the same progress of heat and moisture, and other due temperaments, be converted at the first into flesh and bone, though none be formerly there to joyn it self unto?

Let us then conclude, that the juyce which serveth for nourishment of the animal, being more than is requisite for that service, the superfluous part of it is drained from the rest, and is reserved in a place fit for it: where by little and little, through digestion, it gaineth strength, and vigour, and spirits to it self, and becometh an homogeneous body, such as other simple compounds are; which by other degrees of heat and moisture, is changed into another kind of substance: and that again by other temperaments into another. And thus, by the course of nature, and by passing successively many degrees of temper, and by receiving a total change

change in every one of them; at the length an animal is made of such juyce as afterwards serveth to nourish him.

But to bring this to pass a shorter way, and with greater facility; some have been of opinion, that all similar things of whatsoever substance, are, undiscernably mixed in every thing that is: and that to the making of any body out of any thing, there is no more required but to gather together those Parts which are of that kind, and to separate, and cast away from them, all those which are of a nature differing from them.

4.

Their opinion refused, who hold that every thing containeth formally all things.

But this speculation will appear a very airy and needless one, if we consider into how many several substances the same species of a thing may be immediately changed; or rather how many several substances may be increased immediately from several equal individuals of the same thing; and then take an account how much of each individual is gone into each substance which it hath so increased. For if we sum up the quantities that in the several substances are thereby increased, we shall find that they do very much exceed the whole quantity of any one of the individuals: which should not be if the supposition were true; for every individual should be but one total made up of the several different similar parts, which increase the several substances, that extract out of them what is of their own nature.

This will be better understood by an example: suppose that a man, a horse, a cow, a sheep, and 500. more several species of living creatures, should make a meal of lettuce: to avoid all perplexity in conceiving the argument, let us allow that every one did eat a pound; and let us conceive another pound of this herb to be burned; as much to be putrified under a cabbage root; and the like under 500 plants more of divers species. Then cast how much of every pound of lettuce is turned into the substances that are made of them, or that are increased by them; as, how much ashes one pound hath made; how much water hath been distilled out of another pound; how much a man hath been increased by a third; how much a horse by a fourth; how much earth by the putrefaction of a fifth pound; how much a cabbage hath been increased by a sixth: and so go over all the pounds that have been turned into substances of different specieses (which may be multiplied as much as you please.) And when you have summed up all

all these several quantities, you will find them far to exceed the quantity of one pound: which it would not do, if every pound of lettuce were made up of several different similar parts actually in it, that are extracted by different substances of the natures of those parts; and that no substance could be encreased by it, unless parts of its nature were originally in the lettuce.

5.
The Authors
opinion con-
cerning the ge-
neration of
animals declar-
ed and con-
firmed.

On the other side, if we but cast our eye back upon the principles we have laid, where we discourse of the composition of bodies; we shall discern how this work of changing one thing into another, either in nutrition, in augmentation, or in generation, will appear not onely possible, but easie to be effected. For out of them it is made evident how the several varieties of solid and liquid bodies, all differences of natural qualities, all consistences, and whatsoever else belongeth to similar bodies, resulteth out of the pure and single mixture of rarity and density; so that to make all such varieties as are necessary, there is no need of mingling, or of separating any other kinds of parts: but onely an art or power to mingle in due manner, plain, rare, and dense bodies one with an other. Which very action and none other (but with excellent method and order, such as becometh the great Architect that hath designed it) is performed in the generation of a living creature: which is made of a substance at the first, far unlike what it afterwards groweth to be.

If we look upon this change in gross, and consider but the two extremes (to wit, the first substance, of which a living creature is made, and it self in its full perfection) I confess, it may well seem incredible how so excellent a creature can derive its origine from so mean a principle, and so far remote and differing from what it groweth to be. But if we examine it in retail, and go along anatomising it in every step and degree that it changeth by; we shall find that every immediate change is so near, and so palpably to be made by the concurrent causes of the matter prepared; as we must conclude it cannot possibly become any other thing than just what it doth become.

Take a bean, or any other seed, and put it into the earth, and let water fall upon it; can it then choose but that the bean must swell? The bean swelling, can it choose but break the skin? The skin broken, can it choose (by reason of the heat that is in it)

but

but push out more matter, and do that action which we may call germinating? Can these germs choose but pierce the earth in small strings, as they are able to make their way? Can these strings choose but be hardened, by the compression of the earth, and by their own nature, they being the heaviest parts of the fermented bean? And can all this be any thing else but a root? Afterwards the heat that is in the root, mingling it self with more moisture, and according to its nature, springing upwards, will it not follow necessarily, that a tender green substance (which we call a bud, or leaf) must appear a little above the earth; since tenderness, greenness, and ascent, are the effects of those two principles, heat and moisture? And must not this green substance change from what it was at the first, by the sun and air working upon it, as it groweth higher; till at the length it hardeneth into a stalk? All this while, the heat in the root sublimeth up more moisture, which maketh the stalk at the first grow rank and increase in length: But when the more volatile part of that warm juice, is sufficiently depured and sublimed, will it not attempt to thrust it self out beyond the stalk with much vigour and smartness? And as soon as it meeteth with the cold air in its eruption, will it not be stopped and thickned? And new parts flocking still from the root, must they not clog that issue, and grow into a button, which will be a bud? This bud being hardened at the sides, by the same causes which hardened the stalk, and all the while the inward heat still streaming up, and not enduring to be long enclosed, (especially when by its being stopped it multiplyeth it self) will it not follow necessarily that the tender bud must cleave, and give way to that spiritual juice; which being purer than the rest (through its great sublimation) sheweth it self in a purer and nobler substance than any that is yet made; and so becometh a flower? From hence, if we proceed as we have begun, and do weigh all circumstances, we shall see evidently that another substance must needs succeed the flower, which must be hollow and contain a fruit in it: and that this fruit must grow bigger and harder. And so, to the last period of the generation of new beans.

Thus by drawing the thrid carefully along through your fingers, and staying at every knot to examine how it is tyed; you see that this difficult progress of the generation of living creatures,

creatures, is obvious enough to be comprehended; and that the steps of it are possible too: set down; if one would but take the pain and afford the time that is necessary (less than that Philosopher, who for so many years gave himself wholly up to the single observing of the nature of bees) to note diligently all the circumstances in every change of it. In every one of which the thing that was, becometh absolutely a new thing; and is endued with new properties and qualities different from those it had before, as Physicians from their certain experience do assure us. And yet every change is such, as in the ordinary and general course of nature (wherein nothing is to be considered, but the necessary effects following out of such Agents working upon such patients, in such circumstances) it is impossible that any other thing should be made of the precedent, but that which is immediately subsequent unto it.

Now if all this orderly succession of mutations be necessarily made in a bean, by force of sundry circumstances and external accidents; why may it not be conceived that the like is also done in sensible creatures; but in a more perfect manner, they being perfecter substances? Surely the progress we have set down is much more reasonable, than to conceive that in the meal of the bean are contained in little, several similar substances; as of a root, of a leaf, a stalk, a flower, a cod, fruit, and the rest; and that every one of these, being from the first still the same that they shall be afterwards, do but suck in more moisture from the earth, to swell and enlarge themselves in quantity. Or that in the seed of the male, there is already in act, the substance of flesh of bone, of sinews, of veins, and the rest of those several familiar parts which are found in the body of an animal; and that they are but extended to their due magnitude, by the humidity drawn from the mother, without receiving any substantial mutation from what they were originally in the seed.

Let us then confidently conclude, that all generation is made of a fitting, but remote, homogeneous compounded substance: upon which, outward agents, working in the due course of nature, do change it into another substance, quite different from the first, and do make it less homogeneous than the first was. And other circumstances & agents do change this second into a third; that third into a fourth; and so onwards, by successive mutations
(that

(that still make every new thing become less homogeneal, than the former was, according to the nature of heat, mingling more and more different bodies together) until that substance be produced, which we consider in the period of all these mutations.

And this is evident out of many experiences: as for example in trees; the bark which is opposed to the north wind, is harder and thicker than the contrary side which is opposed to the south, and a great difference will appear in the grain of the wood; even so much, that skilfull people will by feeling and seeing a round piece of the wood after the tree is felled, tell you in what situation it grew, and which way each side of that piece looked. And *Josephus Acoſta* writeth of a tree in *America*, that on the one side being situated towards great hills, and on the other being exposed to the hot Sun; the one half of it flourisheth at one time of the year, and the other half at the opposite season. And some such like may be the cause of the strange effects we sometimes see of trees, flourishing or bearing leaves at an unreasonable time of the year; as in particular, in the famous oke in the *New Forest*, and in some others in our Island: in which peradventure the soil they grow in, may do the same effect, as the winds and Sun did in the tree that *Acoſta* maketh mention of. For we daily see how some soils are so powerfull over some kind of corn, that they will change the very nature of it; so that you shall reap oats or rice, after you have sown wheat there.

Which sheweth evidently that since the outward circumstances can make the parts or the whole of any substance, become different from what they were at the first; generation is not made by aggregation of like parts to presupposed like ones: nor by a specifical worker within; but by the compounding of a seminary matter, with the juice which accrueeth to it from without, and with the steams of circumstant bodies; which by an ordinary course of nature, are regularly imbibed in it by degrees; and which at every degree, do change it into a different thing, such an one as is capable to result out of the present compound, (as we have said before) until it arrive to its full perfection.

Which yet is not the utmost period of natures changes; for
S from

That one substance is changed into another.

from that, for example, from corn or an animal, it carrieth it on (still changing it) to be meal or a cadaver; from thence to be bread or dirt; after that to be bloud or grasse. And so, still turning about her wheel (which suffereth nothing to remain long in the state it is in) she changeth all substances from one into another. And by reiterated revolutions, maketh in time every thing of every thing: as when of mud she maketh tadpoles, and frogs of them; and afterwarde, mud again of the frogs: or when she runneth a like progresse; from earth to worms; and from them, to flies; and the like: so changing one animal into such another; as in the next precedent step, the matter in those circumstances is capable of being changed into; or rather (to say better) must necessarily be changed into.

To confirm this by experience; I have been assured, by one who was very exact in noting such things; that he once observed in *Spain*, in the spring season, how a stick lying in a moist place, grew in tract of time to be most of it a rotten durty matter; and that at the durty end of the stick, there began a rude head to be formed of it by little and little; and after a while some little legs began to discover themselves neer this unpolish'd head, which daily grew more and more distinctly shap'd. And then, for a pretty while (for it was in a place where he had the conveniency to observe daily the progresse of it, and no body came neer to stir it in the whole course of it) he could discern where it ceased to be a body of a living creature, and where it began to be dead stick or dirt; all in one continuat quantity or body. But every day the body grew longer and longer, and more legs appeared, till at the length, when he saw the animal almost finish'd, and neer separating it self from the rest of the stick, he staid then by it, and saw it creep away in a caterpillar, leaving the stick and dirt, as much wanting of its first length, as the worms body took up. Peradventure the greatest part of such creatures maketh their way by such steps into the world. But to be able to observe their progresse thus distinctly as this Gentleman did, happeneth not frequently.

7.
Concerning
the hatching

Therefore, to satisfie our selves herein it were well we made our remarks in some creatures that might be continually, in our power

power to observe in them the course of nature every day and hour. Sir *John Heydon*, the Lieutenant of his Majesties Ordnance (that generous and knowing Gentleman; and consummate souldier both in theory and practice) was the first that instructed me how to do this, by means of a furnace so made as to imitate the warmth of a sitting hen. In which you may lay several egges to hatch; and by breaking them at several ages, you may distinctly observe every hourly mutation in them, if you please. The first will be, that on one side you shall find a great resplendent clearness in the white. After a while, a little spot of red matter like bloud, will appear in the midst of that clearness fastened to the yolk: which will have a motion of opening and shutting; so as sometimes you will see it, and straight again it will vanish from your sight; and indeed at the first it is so little, that you cannot see it, but by the motion of it; for at every pulse, as it openeth, you may see it, and immediately again, it shutteth in such sort, as it is not to be discerned. From this red speck, after a while there will stream out, a number of little (almost imperceptible) red veins. At the end of some of which, in time there will be gathered together, a knot of matter which by little and little will take the form of a head; and you will ere long begin to discern eyes and a beak in it. All this while the first red spot of bloud, groweth bigger and solidier: till at the length, it becometh a fleshy substance; and by its figure, may easily be discerned to be the heart: which as yet hath no other enclosure but the substance of the egge. But by little and little the rest of the body of an animal is framed out of those red veins which stream out all about from the heart. And in process of time, that body incloseth the heart within it by the chest, which groweth over on both sides, and in the end meeteth, and closeth it self fast together. After which this little creature soon filleth the shell, by converting into several parts of it self all the substance of the egge. And then growing weary of so straight an habitation, it breaketh prison, and cometh out, a perfectly formed chicken.

of chickens,
and the gene-
ration of other
animals.

In like manner: in other creatures; which in Latine are called *Vivipara* (because their young ones are quick in their mothers womb) we have, by the relation of that learned and ex-

ast searcher into nature, Doctor *Harvey*: that the seed of the male after his accoupling with the female, doth not remain in her womb in any sensible bulk: but (as it seemeth) evaporateth and incorporateth it self, either into the body of the womb, or rather into some more interior part, as into the seminary vessels. Which being a solid substance, much resembling the nature of the females seed, is likely to suck up, by the mediation of the females seed, the males seed incorporated with it, and by incorporation, turned as it were into a vapor: in such sort as we have formerly explicated how the body of a Scorpion or Viper draweth the poyson out of a wound. And after a certain time Doctor *Harvey* noted the space of six weeks or two moneths in Does or Hinds) these seeds distill again into the womb; and by little and little do clarify in the midst, and a little red speck appeareth in the center of the bright clearness: as we said before of the egge.

8. But we should be too blame to leave our Reader without clearing that difficulty, which cannot choose but have sprung up in his thoughts, by occasion of the relations we made at the entrance into this point concerning the Cat whose kitlings were half with tails, and halt without: and the womans daughters at *Agiers*, that had as well as their mother excrescences upon their left thumbs, imitating another leffer thumb: and the like effects whosoever they happen, which they do frequently enough.

Let him therefore remember, how we have determined that generation is made of the blood, which being dispersed into all the parts of the body to irrigate every one of them; and to convey fitting spirits into them from their source or shop where they are forged; so much of it as is superabundant to the nourishing of those parts is sent back again to the heart to recover the warmth and spirits it hath lost by so long a journey. By which perpetual course of a continued circulation, it is evident that the blood in running thus through all the parts of the body must needs receive some particular concoction or impression from every one of them. And by consequence, if there be any specifical virtue in one part which is not in another, than the blood returning from

from thence must be endued with the virtue of that part. And the purest part of this blood, being extracted like a quintessence out of the whole mass, is reserved in convenient receptacles or vessels, till there be use of it: and is the matter or seed, of which a new animal is to be made; in whom will appear the effect of all the specific virtues drawn by the blood in its iterated courses, by its circular motion, through all the several parts of the parents body.

Whence it followeth, that if any part be wanting in the body whereof this seed is made, or be superabundant in it; whose virtue is not in the rest of the body, or whose superabundance is not allaid by the rest of the body; the virtue of that part cannot be in the blood, or will be too strong in the blood, and by consequence, it cannot be at all, or it will be too much in the seed. And the effect proceeding from the seed, that is, the young animal, will come into the world favoring of that origine; unless the mothers seed do supply or temper, what the fathers was defective or superabundant in; or contrariwise the fathers do correct the errors of the mothers.

But peradventure the Reader will tell us, that such a specific virtue cannot be gotten by concoction of the blood; or by any pretended impression in it; unless some little particles of the nourished part do remain in the blood, and return back with it, according to that maxim of Geber, *Quid non ingreditur, non immutat*: no body can change another unless it enter into it, and mixing it self with it do become one with it. And that so in effect, by this explication we fall back into the opinion which we rejected.

To this I answer, that the difference is very great between that opinion and ours; as will appear evidently, if you observe the two following assertions of theirs. First, they affirm that a living creature is made merely by the assembling together of similar parts, which were hidden in those bodies from whence they are extracted in generation: whereas we say that blood coming to a part to irrigate it, is by its passage through it, and some little stay in it, and by its frequent returns thither, at the length transmuted into the nature of that part: and thereby the specific virtues of every part do grow greater, and are more diffused and extended.

Secondly, they say, that the embryo is actually formed in the seed, though in such little parts as it cannot be discerned until each part have enlarged and increased it self, by drawing unto it from the circumstant bodies more substance of their own nature. But we say, that there is one homogeneal substance made of the blood, which hath been in all parts of the body; and this is the seed: which containeth not in it, any figure of the animal from which it is refined, or of the animal into which it hath a capacity to be turned (by the addition of other substances) though it have in it the virtues of all the parts it hath often run through.

By which terms of specifick virtues, I hope we have said enough in sundry places of this discourse to keep men from conceiving that we do mean any such unconceivable quality, as modern philosophers too frequently talk of, when they know not what they say or think, nor can give any account of. But that it is such degrees and such numbers, of rare and dense parts mingled together, as constitute a mixed body of such a temper and nature: which degrees and proportions of rare and dense parts, and their mixture together, and incorporating into one homogeneal substance, is the effect resulting from the operations of the exteriour agent, that cutteth, imbibeth, kneadeth, and boyleth it to such a temper: which exteriour agent in this case, is each severall part of the animals body that this juyce or blood runneth through; and that hath a particular temper belonging to it, resulting out of such a proportion of rare and dense part, as we have even now spoken of; and can no more be withheld from communicating its temper to the blood that first soaketh into it, and soon after draineth away again from it (according as other succeeding parts of blood drive it on;) than a mineral chanel can choose but communicate its virtue unto a stream of water that runneth through it, and is continually grating off some of the substance of the mineral earth, and dissolving it into it self.

10. But to go on with our intended discourse. The seed thus imbued with the specifick virtues of all the severall parts of the parents body, meeting in a fit receptacle the other parents seed; and being there duly concocted, becometh first a heart: which heart

That the heart is imbued with the generall specifick virtues of the

heart in this tender beginning of a new animal containeth the several virtues of all the parts that afterwards will grow out of it, and be in the future animal; in the same manner as the heart of a complete animal containeth in it the specifick virtues of all the several parts of its own body, by reason of the blouds continual resorting to it in a circle from all parts of its body, and its being nourished by that juice to supply the continual consumption which the extreme heat of it must needs continually occasion in its own substance; whereby the heart becometh in a manner the compendium or abridgement of the whole animal.

whole body;
whereby is
continued the
doctrine of the
two former
paragraphes.

Now this heart in the growing Embryon, being of the nature of fire, as on the one side it streameth out its hot parts; so on the other it sucketh oyl or fewel to nourish it self out of the adjacent moist parts; which matter aggregated unto it, being sent abroad together with the other hot parts that steam from it; both of them together do stay and settle as soon as they are out of the reach of that violent heat, that would not permit them to thicken or to rest. And there they grow into such a substance as is capable to be made of such a mixture, and are linked to the heart by some of those strings that steam out from it (for those steams do likewise harden, as we shewed more particularly when we discoursed of the tender stalks of plants) and in a word, this becometh some other part of the animal. Which thus encreaseth by order, one part being made after another, untill the whole living creature be completely framed.

So that now you see how mainly their opinion differeth from ours; since they say that there is actually in the seed a complete living creature; for what else is a living creature, but bones in such parts, nerves in such others, blood and humours contained in such and such places, all as in a living creature? All which they say. But we make the seed to be nothing else but one mix'd body, of one homogeneal nature throughout; consisting of such a multiplicity of rare and dense parts; so ballanced and proportioned in number and in magnitude of those parts; which are evenly shuffled, and alike mingled in every little parcel of the whole substance: in such sort, that the operati-

on of nature upon this seed, may in a long time and with a due process, bring out such figures, situation, and qualities (as fluidity, consistence, driness, and the like) which by much mixture and consequent alteration, may in the end become such as constitute a living creature of such a kind. And thus it appeareth, that although other substances, and liquors, and steams, are from time to time mingled with the seed, and then with the heart, and afterwards with the other parts, as they grow on and encrease; yet the main virtue of the ensuing animal, is first in the seed, and afterwards in the heart.

Whence the reason is evident, why both defects and excrescences do pass sometimes from the parents to the children; to wit, when nothing supplyeth the defect or correcteth the exorbitancy. Rather after this which we have said, the difficulty will appear greater, in that such accidents are not alwaies hereditary from the parents; but happen only now and then some rare times. But the same grounds we have laid will likewise solve this objection: for seeing that the heart of the animal, from whence the seed receiveth its proper nature (as we have declared) is impregnated with the specifick virtue of each severall part of the body; it cannot be doubted but that the heart will supply for any defect happened in any part, after it hath been imbued with that virtue, and is grown to a firmness, and vigorous consistence with that virtue moulded, and deeply imbibed into the very substance of it. And although the heart should be tinged from its first origine with an undue virtue from some part (as it seemeth to have been in the mother of those daughters that had two thumbs upon one hand;) yet it is not necessary that all the off-spring of that parent should be formed after that model; for the other partners seed may be more efficacious, and predominate in the geniture, over the faulty seed of the other parent; and then it will supply for and correct the others deviation from the general rule of nature. Which seemeth to be the case of that womans male children; for in them the fathers seed being strongest, all their sengers imitated the regularity of their fathers: whereas the daughters (whose sex implieth that the fathers seed was less active) carried upon some of theirs, the resemblance of their mothers irregularity.

And

And in confirmation of this doctrine, we daily see that the children of parents who have any of their noble parts much and long distempered, whereby there must be a great distemper in the blood (which is made and concocted by their assistance) do seldom fail of having strong inclinations to the distempers and diseases that either of their parents were violently subject unto. Scarce any father or mother dyeth of the consumption of the lungs, but their children inherit that disease in some measure: the like is of the stone; the like of the gout; the like of diseases of the brain, and of sundry others; when they infected the parents with any notable eminency: For the blood coming continually to the heart from such ill-affected parts, by its circulation through the whole body, must needs in process of time alter, and change the temper of the heart: and then both the heart giveth a tainted impression to the blood that must be boyled into seed; and the parts themselves do communicate their debilities and distempers unto it: so that it is no wonder, if the seed do partake of such depraved qualities; since it is a maxim among Physicians, that subsequent concoctions can never amend or repair the faults of the precedent ones.

Having waded thus far into this matter, and all experience agreeing that the whole animal is not formed at once: I conceive there can be no great difficulty in determining what part of it is first generated: which we have already said to be the heart; but peradventure the Reader may expect some more particular and immediate proof of it. It is evident that all the motions and changes which we have observed in the Egg and in the Doe, do proceed from heat: and it is as certain that heat is greatest in the center of it: from whence it disperseth it self to less and less. It must then necessarily follow, that the part in which heat doth most abound, and which is the interiour fountain of it, from whence (as from a stock of their own) all the other parts derive theirs, must be formed first, and the others successively after it, according as they partake more or less of this heat; which is the Architect that mouldeth and frameth them all. Undoubtedly this can be none other but the heart: whose motion and manner of working, evidently appears in the twinkling of the first red spot (which is the first change) in the egg, and in the first

II.

That the heart is the first part generated in a living creature.

first matter of other living creatures. Yet I do not intend to say, that the heart is perfectly framed, and completely made up, with all its parts and instruments, before any other part be begun to be made: but onely the most vertuous part; and as it were the marrow of it; which serveth as a shop or a hot forge to mould spirits in: from whence they are dispersed abroad to form and nourish other parts that stand in need of them to that effect.

The shootings or little red strings that stream out from it, must surely be arteries; through which, the blood issuing from the heart, and there made and imbued with the nature of the seed, doth run; till encountering with fit matter, it engrosseth it self into brain, liver, lights, &c. From the brain chiefly groweth the marrow, and by consequent, the bones containing it, (which seem to be originally, but the outward part of the marrow, baked and hardened into a strong crust by the great heat that is kept in:) as also the sinewes; which are the next principal bodies of strength, after the bones. The marrow being very hot drieth the bones; and yet with its actual moisture it humecteth and nourisheth them too, in some sort. The spirits that are sent from the brain do the like to the sinewes. And lastly, the arteries and veins by their blood do cherish and bedew the flesh. And thus the whole living creature is begun, framed, and made vp.

C H A P. XX V.

How a plant or Animal cometh to that figure it hath.

.I
That the figure of an Animal is produced by ordinary second causes, as well as any other corporeal effect.

BUt before we go any farther, and search into the operations of this animal, a wonderfull effect calleth our consideration unto it: which is, how a plant or animal cometh by the figure it hath, both in the whole and in every part of it? *Aristotle*, after he had beaten his thoughts as far as he could upon this question, pronounced that this effect could not possibly be wrought by the virtue of the first qualities; but that it sprung from a more divine origine. And most of the contemplators of Nature since him do seem to agree, that no cause can be referred of it; but that it is to be referred merely to the specifical

nature

nature of the thing. Neither do we intend to derogate from either of these causes; since that both divine providence is eminently shown in contriving all circumstances necessary for this work; and likewise, the first temperament that is in the seed must needs be the principal immediate cause of this admirable effect.

This latter then being supposed; our labour and endeavour will be, to unfold (as far as so weak and dim eyes can reach) the excellency and exactness of Gods providence, which cannot be enough adored, when it is reflected upon, and marked in the apt laying of adequate causes to produce such a figure out of such a mixture first layed. From them so artificially ranged, we shall see this miracle of nature to proceed; and not from an immediate working of God or nature without convenient and ordinary instruments to mediate and effect this configuration, through the force and virtue of their own particular natures. Such a necessity to interest the chief workman at every turn, in particular effects, would argue him of want of skill and providence, in the first laying of the foundations of his designed machin: he were an improvident clock-maker, that should have cast his work so, as when it were wound up and going, it would require the masters hand at every hour to make the hammer strike upon the bell. Let us not then too familiarly, and irreverently ingage the Almighty Architect his immediate handy-work in every particular effect of nature; *Tali non est dignus vindice nodus.*

But let us take principles within our own kenning; and consider how a body hath of its own nature three dimensions, (as Mathematicians use to demonstrate;) and that the variety which we see of figures in bodies proceedeth out of the defect of some of these dimensions in proportion to the rest. As for example, that a thing be in the form of a square tablet; is, for that the cause which gave it length and breadth, could not also give it thickness in the same proportion: for had it been able to give profundity as well as the other two, it had made a cube instead of a tablet. In like manner, the form of a lamine, or very long square is occasioned by some accident which hindereth the cause from giving breadth and thickness proportiona-

2.
That the several figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.

tionable to the length. And so, other figures are made, by reason that their causes are some waies bound to give more of some dimension to one part than to another.

As for example, when water falleth out of the skie, it hath all the little corners or extancies of its body grated off by the air as it rolleth and tumbleth down in it, so that it becometh round; and continueth in that form, until that falling upon some flat body, as grasse, or a leaf, it receiveth a little plainness, to the proportion of its weight mastering the continuity of it. And therefore, if the drop be great upon that plain body, it seemeth to be half a sphere, or some less portion of one: but if it be a little drop then the flat part of it (which is that next unto the grasse) is very litle and undiscernable, because it hath not weight enough to press it much and spread it abroad upon the grasse; and so the whole seemeth in a manner to be a sphere: but if the extern causes had pressed upon this drop, onely broadwaies and thickwaies (as when a turner maketh a round pillar of a square one) then it would have proved a cylinder, nothing working upon it to grate off any of its length, but onely the corners of the breadth and thickness of it.

And thus you see, how the fundamental figures (upon which all the rest are grounded) are contrived by nature; not by the work of any particular Agent that immediately imprinteth a determinate figure into a particular body, as though it wrought it there at once, according to a foreconceived designe or intelligent aim of producing such a figure in such a body: but by the concurrence of several accidental causes, that do all of them joyn in bringing the body they file and work upon, into such a shape.

Onely we had like to have forgotten the reason and cause of the concave figure in some parts of plants: which in the ordinary course of nature we shall find to grow from hence, that a round outside being filled with some liquour which maketh it grow higher and higher, it happeneth that the succeeding causes do contract this liquour, and do harden the outside: and then of necessity there must be a hollow cylinder remaining in lieu of the juyce which before did fill it. As we see every day in corn,
and

and in reeds, and in canes, and in the stalks of many herbs: which whilst they are tender and in thir first groweth, are full of juice, and become afterwards hollow and dry.

But because this discourse, may peradventure seem too much in common: it will not be amiss to apply it to some particulars that seem very strange. And first, let us examine how the rooking of concrete juices (which seemeth to be such an admirable mystery of nature) is performed. Allom falleth down in lumps, saltpeter in long icicles, and common salt in squares; and this, not once, or sometimes now and then; but alwaies constantly in the same order.

3.
The former doctrine is confirmed by several instances.

The reason of these effects will easily be deduced out of what we have said, for if all three be dissolved in the same water, allom being the grossest falleth first and fastest: and being of an unctious nature, the first part which falleth doth not harden till the second cometh to it; whereby this second sticketh to the first and crusheth it down, and this is served in the same manner by the third; and so goeth on, one part squeezing another, till what is undermost grow hard enough to resist the weight of new falling parts; or rather till no more do fall, but the liquor they were dissolved in, is delivered of them all, and then they harden in that figure they were compressed into.

As for salt, which descendeth in the second place: that swimmeth first upon the water; and there getteth its figure, which must be equally long and broad, because the water is indifferent to those two positions; but its thickness is not equal to its other two dimensions, by reason that before it can attain to that thickness, it groweth too heavy to swimme any longer; and after it is encreased to a certain bulk, the weight of it carrieth it down to the bottom of the water, and consequently, it can encrease no more: for it encreaseth by the joyning of little parts unto it as it swimmeth on the top of the water.

The saltpeter falleth last: which being more difficult to be figured than the other two, because it is more dry than either of them (as consisting chiefly of earthy and of fiery parts,) is not equally encreased, neither in all three, nor in two dimensions, but hath its length exceeding both its breadth and thickness:
and

and its lightness maketh it fall, because it requireth least water to sustain it.

To give the causes of the figures of divers mixts, and particularly of some precious stones, (which seem to be cast by nature in exactest moulds) would oblige us to enter into the particular manner of their generation: which were exceeding hard, if not impossible, for us to do, by reason that Authours have not left us the circumstances upon which we might ground our judgement concerning them, so particularly described as were necessary; nor our selves have met with the commodity of making such experiences, and of searching so into their beds as were requisite, to determine solidly the reasons of them. And indeed I conceive that oftentimes the relations which others have recorded of their generation, would rather mislead than assist us: since it is very familiar in many men, to magnifie the exactness of nature in framing effects they fanfie to themselves, when to make their wonder appear more just; they will not fail to set off their story, with all advantageous circumstances, and help out what wanteth a little or cometh but neerer the mark.

4. But to come closer to our purpose; that is, to the figures of
 The same doctrine applied to Plants. living things: we see that roots in the earth are all of them figured almost in the same fashion: for the heat residing in the middle of them, pusheth every way, and thereupon, some of them do become round, but others more long than round, according to the temper of the ground, or to the season of the year, or to the weather that happeneth: and this, not onely in divers kindes of roots, but even in several of the same kind. That part of the plant which mounteth upwards is for the most part round and long; the cause whereof is evident, for the juice which is in the middle of it working upwards (because the hardness of the bark will not let it out at the sides) and coming in more and more abundance (for the reasons we have above delivered) encreaseth that part equally every way but upwards; and therefore, it must be equally thick and broad, and consequently round: but the length will exceed either of the other dimensions; because the juice is driven up with a greater force and in more quantity than it is to the sides. Yet the

the broadness and thickness are not so exactly uniform, but that they exceed a little more at the bottom than at the top; which is occasioned partly by the contracting of the juice into a narrower circuit the farther it is from the source; and partly by reason of the branches; which shooting forth, do convey away a great part of the juice from the main stock.

Now if we consider the matter well; we shall finde, that what is done in the whole tree, the very same is likewise done in every little leaf of it: for a leaf consisteth of little branches shooting out from one greater branch, which is in the middle: and again, other lesser branches are derived from those second branches: and so still lesser and lesser, till they weave themselves into a close work, as thick as that which we see women use to fill up with silk or crewel, when in tent-work they embroider leaves or flowers upon canvas: and this again, is covered and as it were glewed over, by the humour which sticking to these little thrids, stoppeth up every little vacuity, and by the air is hardned into such a skin as we see a leaf consisteth of.

5.

The same doctrine declared in leaves of trees

And thus it appeareth how an account may be given of the figure of the leaf, as well as of the figure of the main body of the whole tree: the little branches of the leaf, being proportionate in figure to the branches of the tree it self (so that each leaf seemeth to be the tree in little;) and the figure of the leaf depending of the course of these little branches, so that if the greatest branch of the tree be much longer than the others, the leaf will be a long one: but if the lesser branches spread broadwaies, the leaf will likewise be a broad one; so far, as even to be notched at the outsides, round about it, in great or little notches, according to the proportion of the trees branches. These leaves, when they first break out, are foulded inward, in such sort as the smallness and roundness of the passage in the wood through which they issue, constraineth them to be: where nevertheless the driness of their parts keep them asunder, so that one leaf doth not incorporate it self with another: but as soon as they feel the heat of the Sun (after they are broken out into liberty) their tender branches by little and little grow

grow more straight: the concave parts of them drawing more towards the Sun, because he extracteth and sucketh thir moisture from their hinder parts into their former, that are more exposed to his beams; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which if it be in excess, maketh the leaf become crooked the contrary way, as we see in divers flowers, and in sundry leaves during the Summers heat: witness, the Ivie, Roses full blown, Tulips, and all flowers in form of bells: and indeed all kindes of flowers whatsoever, when the Sun hath wrought upon them to that degree we speak of, and that their joyning to their stalk, and the next parts thereunto, allow them scope to obey the impulse of those outward causes. And when any do vary from this rule, we shall as plainly see other manifest causes producing those different effects, as now we do these working in this manner.

As for fruits though we see that when they grow at liberty upon the tree, they seem to have a particular figure allotted them by nature: yet in truth, it is the ordered series of natural causes and not an intrinsical formative virtue which breedeth this effect, as is evident by the great power which art hath to change their figures at pleasure: whereof you may see examples enough in *Campanella*, and every curious gardner can furnish you with store.

6. O it of these, and such like principles a man that would make it his study with less trouble or tediousness, than that putient contemplator of one of Natures little works (the Bee) whom we mentioned a while ago, might without all doubt trace the causes in the growing of an Embryon, till he discovered the reason of every bones figure; of every notable hole or passage that is in them: of the Ligaments by which they are tied together: of the membranes that cover them, and of all the other parts of the body. How, out of a first masse, that was soft, and had no such parts distinguishable in it, every one of them came to be formed, by contracting that mass in one place, by dilating it in another, by moistning it in a third, by drying it here, hardening it there.

The same applied to the bodies of Animals.

— *Ut his exordia primis,*

Omnia, & ipse tener hominis concreverit orbis.

till in the end this admirable machine and frame of mans body, was composed and fashioned up by such little, and almost insensible steps and degrees. Which when it is looked upon in bulk, and entirely formed, seemeth impossible to have been made, and to have sprung meerly out of these principles, without an intelligence immediately working and moulding it at every turn, from the beginning to the end.

But withall, we cannot choose but break out into an extasie of admiration and hymns of praise (as great *Galen* did upon the like occasion) when we reverently consider the infinite wisdom, and deep far-looking providence of the all-seeing Creator and orderer of the world, in so punctually adapting such a multitude and swarm of causes to produce by so long a progress so wonderfull an effect: in the whole course of which, if any one, the very least of them all, went never so little awry, the whole fabrick would be discomposed and changed from the nature it is designed unto.

Out of our short survey of which (answerable to our weak talents, and slender experience) I perswade my self it appeareth evident enough, that to effect this work of generation, there needeth not be supposed a forming virtue, or *Vis formatrix* of an unknown power and operation, as those that consider things suddenly, and but in gross, do use to put. Yet in discourse, for conveniency and shortness of expression, we shall not quite banish that term from all commerce with us; so that what we mean by it be rightly understood, which is the complex assemblment, or chain of all the causes, that concur to produce this effect, as they are set on foot to this end by the great Architect and Moderator of them, God Almighty, whose instrument Nature is: that is, the same thing, or rather the same things so ordered as we have declared, but expressed and comprised under another name.

7.

In what sense
the Authour
doth admit of
Vis formatrix.

T

CHAP.

C H A P. XXVI.

How motion beginneth in living creatures. And of the motion of the heart ; circulation of the blood ; Nutrition, Augmentation, and corruption or death.

I.
From whence
doth proceed
the primary
motion and
growth in
plants.

BUT we must not take our leave of this subject, until we have examined, how motion beginneth in living things ; as well plants as sensitive creatures. We can readily pitch upon the part we are to make our observation in, for retrieving the origine of this primary motion : for having concluded, That the roots of plants, and the hearts of animals, are the parts of them which are first made, and from which the forming virtue is derived to all the rest, it were unreasonable to seek for their first motion any where else.

But in what manner, and by what means, doth it begin there ? for roots, the difficulty is not great : for the moisture of the earth pressing upon the seed, and soaking into it ; the hot parts of it which were imprisoned in cold and dry ones, are thereby stirred up and set on work : then they mingling themselves with that moisture, do ferment and distend the whole seed ; till making it open, and break the skin, more juyce cometh in : which incorporating it self with the heat, those hot and now moist parts will not be contained in so narrow a room as at the first ; but struggling to get out on all sides, and striving to enlarge themselves, they thrust forth little parts : which, if they stay in the earth, do grow white, and make the root ; but those which ascend, and make their way into the air, being less compressed, and more full of heat and moisture, do turn green : and as fast as they grow up, new moisture coming to the root, is sent up through the pores of it : and this faileth not, until the heat of the root it self doth fail. For it being the nature of heat to rarifie and elevate, there must of necessity be caused in the earth a kind of sucking in of moisture into the root from the next parts unto it to fill those capacities which the dilating heat hath made,

that

that else would be empty, and to supply the rooms of those which the heat continually sendeth upwards: for the moisture of the root hath a continuity with that in the earth, and therefore, they adhere together (as in a pump, or rather as in filtration, and do follow one another when any of them are in motion) and still the next must needs come in, and fill the room, where it findeth an empty space immediate to it. The like of which happeneth to the air when we breathe: for our lungs being like a bladder, when we open them, the air must needs come in, to fill that capacity which else would be empty: and when we shut them again, as in a pair of bellows, we put it out.

This may suffice, concerning the primary motion of roots: but in that of the heart, we shall finde the matter not altogether so plain. *Monsieur Des Cartes* following herein the steps of the learned and ingenuous Doctor *Harvey*, who hath invented and teacheth that curious and excellent Doctrine of the circulation of the blood; (as indeed, what secret of nature can be hidden from so sharp a wit, when he applieth himself to penetrate into the bottom of it:) explicateth the matter much after this sort. That the heart, within, in the substance of it, is like a hollow cavern, in whose bottom, were an hot stone, on which should drop as much liquor as the fiery stone could blow into smoke; and this smoke or steam should be more than the cave could contain, wherefore it must break out; which to do, it presseth on all sides to get an issue or door to let it out: it findeth of two sorts, but onely one kind of them will serve it for this purpose; for the one sort of these doors, openeth inwards, the other outwards: which is the cause that the more it striveth to get out, the faster it shutteth the doors of the first kind; but by the same means, it beateth back the other doors, and so getteth out:

2.

Monsieur des Cartes, his opinion touching the motion of the heart.

Now when it is gone quite out of this cavern, and consequently leaveth it to its natural disposition, whereas before it violently stretched it out; and by doing so, kept close the doors that open inwards: then all the parts of it begin to slacken, and those doores give way unto new liquour to drop in anew; which the heat in the bottom of the heart, rarifieth again

into smoke as before. And thus he conceiveth the motion of the heart to be made, taking the substance of it to be (as I may say) like unto limber leather, which upon the filling of it with blood and steam, openeth and dilateth it self: and at the going of it out, it shrinketh together like a bladder.

3.
The former opinion rejected

But I doubt, this explication will not go through the difficulty: for first, both *Galen* and *Doctor Harvey* do shew, that as soon as the blood is come into the heart, it contracteth it self: which agreeth not with *Monsieur des Cartes* his supposition: for in his doctrine, there appeareth no cause why it should contract it self when it is full: but contrariwise, it should go on dilating it self, until enough of the blood which drop-peth into the heart, were converted into steam, to force the doors open; that so, it may gain an issue thence, and a passage into the body.

Next, *Monsieur de Cartes* supposeth that the substance of the heart is like a bladder, which hath no motion of it self, but openeth and shutteth, according as what is within it stretcheth it out, or permitteth it to shrink and fall together again. Whereas *Doctor Harvey* proveth, That when it is full, it compresseth it self by a quick and strong motion, to expell that which is in it: and that when it is empty, it returneth to its natural dilatation, figure and situation, by the ceasing of that agents working, which caused its motion. Whereby it appeareth to be of such a fibrous substance, as hath a proper motion of its own.

Thirdly, I see not how this motion can be proportional: for the heart must needs open and be dilated, much faster than it can be shut and shrink together: there being no cause put to shut it, and to bring it to its utmost period of shrinking, other than the going out of the vapour, whereby it becometh empty: which vapour not being forced by any thing, but by its own inclination, it may peradventure at the first, when there is abundance of it, swell and stretch the heart forcibly out; but after the first impulse and breach of some part of it out of the cavern that enclosed it, there is nothing to drive out the rest, which must therefore steam very leisurely out.

Fourthly,

Fourthly, what should hinder the blood from coming in before the heart be quite empty and shrunk to its lowest pitch? For as soon as the vapour yieldeth within, new blood may fall in from without, and so keep the heart continually dilated, without ever suffering it to be perfectly and completely shut.

Fifthly, the heart of a viper layed upon a plate in a warm place will beat four and twenty hower, and much longer, if it be carefully taken out of its body, and the weather be warm and moyst: and it is clear, that this is without succession of blood to cause the pulses of it. Likewise, the severed members of living creatures will stirr for some time after they are parted from their bodies: and in them, we can suspect no such cause of motion.

Sixthly, in *Monsieur des Cartes* his opinion, the heart should be hardest when it is fullest; and the eruption of the steam out of it, should be strongest at the beginning; whereas experience sheweth, that it is softest when it is at the point of being full, and hardest when it is at the point of being empty; and the motion strongest towards the end.

Seventhly, in *Monsieur des Cartes* his way, there is no agent or force strong enough to make blood gush out of the heart: for if it be the steam onely that openeth the doores, nothing but it will go out; and the blood will still remain behind, since it lieth lower than the steam, and farther from the issue that letteth it out: but doctor *Harvey* findeth by experience (and teacheth how to make this experience) that when a wound is made in the heart, blood will gush out by spurts at every shooting of the heart.

And lastly, if *Monsieur des Cartes* his supposition were true, the arteries would receive nothing but steams; whereas it is evident that the cheif filler of them is blood.

Therefore we must enquire after another cause of this primary motion of a sensitive creature, in the beatings of its heart. Wherein we shall not be obliged to look far: for seeing we find this motion and these pulsations in the heart when it is separated from the body, we may boldly and safely conclude, that it must of necessity be caused by something that is

4.
The Author's
opinion concerning the
motion of the
heart.

within the heart it self. And what can that be else, but heat or spirits imprisoned in a tough viscuous bloud; which it cannot so presently break through to get out; and yet can stir within it and lift it up.

The like of which motion may be observed, in the heaving up, and sinking down again of loose mould thrown into a pit, into which much ordure hath been emptied. The same cause of heat in the earth, maketh mountains and sands to be cast up in the very sea: so, in frying, when the pan is full of meat, the bubbles rise and fall at the edges: treacle and such strong compounded substances, whiles they ferment, do lift themselves up and sink down again, after the same manner as the vipers heart doth: as also do the bubbles of barm, and must of wine, and short ends of lute strings baked in a juicy pie, will at the opening of it move in such sort, as they who are ignorant of the feat will think there are magots in it: and a hot loaf, in which quicksilver is enclosed, will not onely move thus, but will also leap about, and skip from one place to another, like the head or limb of an animal (very full of spirits) newly cut off from its whole body.

And that this is the true cause of the hearts motion, appeareth evidently. First, because this virtue of moving is in every part of the heart, as you will plainly see if you cut into several pieces a heart, that conserveth its motion long after it is out of the animals belly: for every piece will move; as Doctor *Harvey* assureth us by experience, and I my self have often seen, upon occasion of making the great antidote, in which vipers hearts is a principal ingredient. Secondly, the same is seen in the auricles and the rest of the heart; whose motions are several; though so near together, that they can hardly be distinguished. Thirdly, Doctor *Harvey* seemeth to affirm that the bloud which is in the ears of the heart, hath such a motion of it self, precedent to the motion of the ears it is in: and that this virtue remaineth in it for a little space after the ears are dead. Fourthly, in touching a heart which had newly left moving, with his finger wetted with warm spittle, it began to move again, as testifying hat heat and moisture made this motion: Fifthly, if you touch the vipers heart over with vinegar,

with²

with spirit of wine, with sharp white wine, or with any piercing liquour; it presently dyeth: for the acuteness of such substances pierceth through the viscuous bloud, and maketh way for the heat to get out.

But this first mover of an animal, must have something from without to stir it up; else, the heat would lie in it, as if it were dead; and in time would become absolutely so. In egges, you see this exteriour mover, is the warmth of the hen hatching them. And in Embryons, it is the warmth of the mothers womb. But when in either of them, the heart is completely formed, and is enclosed in the breast, much heat is likewise enclosed there, in all the parts near about the heart; partly made by the heart it self, and partly caused by the outward heat, which helped also to make that in the heart; and then although the warmth of the hen or of the mothers womb, do forsake the heart; yet this stirreth up the native heat within the heart, and keepeth it in motion, and maketh it feed still upon new fewel, as fast as that which it worketh upon decayeth.

But to express more particularly how this motion is effected; we are to note, that the heart hath in the ventricles of it three sorts of fibers; the first go long waies or are straight ones, on the sides of the ventricles from the thick basis of the heart, towards the little tip or cone of it: the second, go cross or round-ways about the ventricles within the heart: and the third, are transversal or thwart ones. Next, we are to remember, that the heart is fixed to the body by its base; and hangeth loose at the cone. Now then, the fibres being of the nature of such things as will swell and grow thicker by being moistned, and consequently shrink up in length and grow shorter in proportion to their swelling thicker (as you may observe in a loose-wrought hempen rope) it must of necessity follow, that when the bloud falleth into the heart (which is of a kind of spungie substance) the fibres being therewith moistned, they will presently swell in roundness and shrink in length.

Next, we are to note, that there is a double motion in the heart, the one of opening, which is called, Diastole; the other of shutting, which is termed Sytsole. And although Doctor Harvey seemeth to allow the opening of the heart to be no motion;

but rather a relenting from motion; nevertheless (me thinketh) it is manifest, that it is not onely a compleat motion; but in a manner the greater motion of the two, though indeed the less sensible; because it is performed by little and little; for in it the heart is drawn by violence from its natural position; which must be (as it is of all heavy things) that by which it approacheth most to the center of gravity; and such a position we see it gaineth by the shutting of it.

Now to declare how both these motions are effected, we are to consider how at the end of the systole the heart is voided and cleansed of all the blood that was in it; whence it followeth, that the weight of the blood which is in the auricles, pressing upon the *valvulas* or doores that open inwards, maketh its way by little and little into the ventricles of the heart, where it must necessarily swell the fibers; and they being swelled must needs draw the heart into a roundish and capacious figure, which the more it is done, the more blood cometh in, and with greater violence. The following effect of which must be, that the weight of the blood joyned to the weight of the heart it self, and particularly of the *conus* or tip (which is more solid and heave in proportion to its quantiy, than the rest of the heart) must necessarily set the heart into the natural motion of descending according to its gravity: the which consequently, is performed by a lively jerck, whereby it cometh to pass that the tip of our heart doth as it were spring up towards our breast: and the blood is spurted out by other *valvule* (that open outwards) which are aptly disposed to be opened upon such a motion, and do convey it to the arterie.

In the course of which motion, we may note how the figure of our heart contributeth to its springing up towards our breast; for the line of distance which is between the basis & the tip being longer on that side which is towards the back, than on the other which is towards the breast, it must happen that when the heart shutteth and straightneth it self, and thereby extendeth it self to its length, the tip will butt out forwards towards the breast.

6. Against this doctrine of the motion, and of the systole and diastole of the heart, it may be objected, that beasts hearts do not hang like a mans heart, straight downwards; but rather horizontally; and therefore this motion of gravity cannot have place

An objection
answered a.
gainst the for-
mer doctrine,

place in them : nevertheless, we are sure they beat, and do open and shut regularly. Besides, if there were no other cause but this of gravity for the motion of a mans heart, it would follow that one who were set upon his head, or hung by his heels, could not have the motion of his heart : which posture nevertheless, we see men remain in for a pretty while, without any extreme prejudice.

But these difficulties are easily answered ; for whether beasts hearts do lie directly horizontally, or whether the basis be fastened somewhat higher than the tip reacheth, and so maketh their heart hang inclining downwards ; still the motion of gravity hath its effect in them. As we may perceive in the heart of a viper being upon a plate, and in any other thing that of it self swelleth up, and straight again sinketh down : in which we cannot doubt, but that the gravity fighting against the heat, maketh the elevated parts to fall, as the heat maketh them rise.

And as for the latter ; it is evident that men cannot stay long in that posture without violent accidents ; and in any little while we see that the blood cometh into their face and other parts which naturally are situated higher ; but by this position become lower than the heart : and much time is not required, to have them quite disordered and suffocated ; the blood passing through the heart with too much quickness, and not receiving due concoction there ; and falling thence in too great abundance into places that cannot with conveniency entertain it.

But you will insist, and ask, whether in that posture the heart doth move or no, and how ? And to speak by guess in a thing I have not yet made experiences enough to be thoroughly informed in ; I conceive without any great scruple that it doth move. And that it happeneth thus ; that the heart hanging somewhat loose, must needs tumble over, and the tip of it lean downwards some way or other ; and so lie in part like the heart of a beast ; though not so conveniently accommodated : and then the heat which maketh the viscuous blood that is in the substance of the heart to ferment, will not fail of raising it up : whereupon the weight of that side of the heart that is lifted up, will presently press it down again. And thus, by the alternative operations of these

caus. 8,

causes the heart will be made to open and shut it self, as much as is necessary for admitting and thrusting out that little and disorderly coming blood, which maketh its course through it, for that little space wherein the man continueth in that position.

7.
The circulation of the blood and other effects that follow the motion of the heart.

Now from these effects wrought in the heart by the moistening of the fibres, two other effects do proceed: the one is, that the blood is pushed out of every corner of the heart with an impetuosity or velocity. The other is, that by this motion the spirits which are in the ventricles of the heart, and in the blood, that is even then heated there, are more and deeper pressed into the substance of the heart, so that you see the heart imbibeth fresh vigour, and is strengthened with new spirits, whiles it seemeth to reject that which should strengthen it.

Again, two other effects follow this violent ejection of the blood out of the heart. The one is, that for the present the heart is entirely cleansed of all remainders of blood, none being permitted to fall back to annoy it. The other is, that the heart finding it self dry, the fibres do relent presently into their natural position and extension, and the *valvulæ* that open inwards, fall flat to the sides of the ventricles, and consequently new blood droppeth in. So that in conclusion, we see the motion of the heart dependeth originally of its fibres irrigated by the blood, and not from the force of the vapour, as *Monsieur des Cartes* supposeth.

This motion of the heart driveth the blood (which is warmed and spiritualized, by being boyled in this furnace) through due passages into the arteries, which from them runneth into the veins; and is a main cause of making and nourishing other parts; as the liver, the lungs, the brains, and whatsoever else dependeth of those veins and arteries through which the blood goeth. Which being ever freshly heated, and receeiving the tincture of the hearts nature, by passing through the heart, wheresoever it stayeth and curdleth, it groweth into a substance of a nature conformable to the heart, though every one of such substances be of exceeding different conditions in themselves, the very grossest excrements not being excluded from some participation of that nature.

But

But if you desire to follow the bloud all along every step in its progress from the heart round about the body, till it return back again to its center, Doctor *Harvey* who most acutely teacheth this doctrine, must be your guide. He will shew you how it issueth from the heart by the arteries, from whence it goeth out warming the flesh, until it arrive to some of the extremities of the body: and by then it is grown so cool (by long absence from the fountain of its heat, and by evaporating its own stock of spirits, without any new supply) that it hath need of being warmed anew; it findeth it self returned back again to the heart, and is there heated again, which return is made by the veins, as its going forwards is performed onely by the arteries.

And were it not for this continual circulation of the bloud, and this new heating it in its proper caldron, the heart; it could not be avoided but that the extreme parts of the body would soon grow cold and die. For flesh being of it self of a cold nature (as is apparent in dead flesh) and being kept warm, merely be the bloud that bedeweth it; and the bloud likewise being of a nature that soon groweth cold and congealeth, unless it be preserved in due temper by actual heat working upon it: how can we imagine that they two singly, without any other assistance, should keep one another warm (especially in those parts that are far distant from the heart) by onely being together? Surely we must allow the bloud, (which is a substance fit for motion) to have recourse back to the heart, where onely it can be supplied with new heat and spirits) and from thence be driven out again by its pulses or strokes, which are his shottings. And as fast as it flieth out, (like a reeking thick steam, which riseth from perfumed water falling upon a heated pan) that which is next before it must flie yet farther on, to make way for it; and new arteriāl bloud still issuing forth at every pulse, it must still drive on what issued thence the last precedent pulse, and that part must press on what is next before it. And thus it fareth with the whole mass of bloud, which having no other course but in the body, it must at length run round, and by new vessels (which are the veins) return back unto the place from whence it issued first: and by that time it cometh thither, it is grown cool and thick, and needeth a vigorous restoration of spirits

spirits and a new rarifying; that then it may warm the fl. sh it passeth again through: without which it would suddenly grow stone cold, as is manifest if by tying or cutting the arteries, you intercept the blood, which is to nourish any part: for then that part groweth presently cold and benumbed.

8.
Of Nutrition.

But referring the particulars of this doctrine unto Doctor *Harvey* (who hath both invented and perfected it) our task in hand calleth upon us to declare in common the residue of motions that all living creatures agree in. How generation is performed we have determined in the past discourse. Our next consideration then ought to be of Nutrition and Augmentation. Between which there is very little difference in the nature of their action, and the difference of their names is grounded more upon the different results in the period of them, than upon the thing it self; as will by and by appear. Thus then is the progress of this matter: as soon as a living creature is formed, it endeavoreth straight to augment it self; and employeth it self onely about that; the parts of it being yet too young and tender to perform the other functions which nature hath produced them for. That is to say; the living creature, at its first production, is in such a state and condition as it is able to do nothing else, but (by means of the great heat that is in it) to turn into its own substance the abundance of moisture that overfloweth it.

They who are curious in this matter, do tell us that the performance of this work consisteth in five actions; which they call Attraction, Adhesion, Concoction, Assimilation, and Union. The nature of attraction we have already declared when we explicated how the heart and the root sendeth juyce into the other parts of the animal or plant: for they abounding in themselves with inward heat, and besides that, much other circumstance heat working likewise upon them; it cannot be otherwise but that they must needs suck and draw into them, the moisture that is about them.

As for adhesion, the nature of that is likewise explicated, when we shewed how such parts as are moist, but especially aerial or oily ones (such as are made by the operation of a soft and continual heat) are catching, and do easily stick unto any
body

body they happen to touch : and how a little part of moisture between two dry parts, joyneth them together. Upon which occasion, it is to be noted, that parts of the same kind do joyn best together : and therefore the powder of glass is used to cement broken glass withall (as we have touched somewhere above :) and the powder of marble to cement marble with ; and so of other bodies : in like mannet, Alchymists find no better expedient to extract a small proportion of silver mixed with a great one of gold, than to put more silver to it : nor any more effectual way to get out the heare, or tincture, or spirits of any thing they distill or make an extract of, than to infuse its own flegme upon it, and to water it with that. Now whether the reason of this be, that continuity, because it is an unity, must be firmest between parts that are most conformable to one another, and consequently are most one among themselves ; or whether it be for some other hidden cause, belongeth not to this place to discourse : but in fine so it is. And the adhesion is strongest of such parts as are most conformable to that which needeth encrease and nourishment ; and that is made up by the other three actions.

Of which, concoction is nothing else but a thickning of that juyce which already sticketh to any part of the animals body, by the good digestion that heat maketh in it. And assimilation is the effect of concoction : for this juyce being used in the same manner, as the first juyce was that made the part whereunto this is to be joyned ; it cannot choose but become like unto it in substance : And then, there being no other substance between, it is of it self united unto it without any farther help.

Hitherto this action belongeth to nutrition. But if on the one side, the heat and spirituality of the blood ; and on the other side, the due temper and disposition of the part be such, as the blood is greedily sucked into the part, which thereby swelleth to make room for it, and will not let it go away, but turneth it into a like substance as it self is ; and in greater quantity than what is consumed and decayeth continually by transpiration ; then this action is called likewise augmentation. Which *Galen* explicated by a sport the boyes of *Ionia* used ; who were accustomed to fill a bladder with wind ; and when they could force no more into it, they would rub the bladder, and after rubbing of it, they found

9.

Of Augmentat.
tion.

found it capable of receiving new breath; and so they would proceed on, until their bladder were as full as by use they knew it could be made. Now (saith he) nature doth the like, by filling our flesh and other parts with blood; that is to say, it stretcheth the fibers: but she hath over and above a power which the boys had not; namely, to make the fibers as strong after they are stretched to their utmost extension, as they were before they were extended: whence it happeneth, that she can extend them again as well as at the first; and this without end, as far as concerneth that part.

The reason whereof is, because she extendeth them by means of a liquor which is of the same nature, as that whereof they were made at the first: and from whence it followeth, that by concoction that liquor settleth in the parts of the fibers which have most need; and so maketh those parts as great in the length they are extended unto, as they were in their shortness before they were drawn out. Whereby the whole part of the animal, wherein this happeneth, groweth greater: and the like being done in every part, as well as in any one single one, the whole animal becometh bigger, and is in such sort augmented.

10.
Of death and
sickness.

Out of all which discourse, we may collect, that in the essential composition of living creatures, there may peradventure be a physical possibility for them to continue alwaies without decay; and so become immortal, even in their bodies, if all hurtfull accidents coming from without might be prevented. For seeing that a man, besides the encrease which he maketh of himself, can also impart unto his children a virtue, by which they are able to do the like, and to give again unto theirs as much as they received from their fathers: it is clear, that what maketh him die, is no more the want of any radical power in him, to encrease or nourish himself, than in fire, it is the want of power to burn, which maketh it go out. But it must be some accidental want, which *Galen* attributeth chiefly to the driness of our bones, and sinews, &c. as you may in him see more at large; for driness with density alloweth not easie admittance unto moisture: and therefore it causeth the heat which is in the dry body, either to evaporate, or to be extinguished: and want of heat is that from whence the failing of life proceedeth

eth : which he thinketh cannot be prevented by any art or industry.

And herein God hath expressed his great mercy and goodness towards us : for seeing that by the corruption of our own nature, we are so immersed in flesh and blood, as we should for ever delight to wallow in their mire, without raising our thoughts at any time above that low and brutal condition : he hath engaged us by a happy necessity, to think of, and to provide for a nobler, and far more excellent state of living, that will never change, or end.

In pursuance of which inevitable ordinance, man (as if he were grown weary and out of love with this life, and scorned any term in his farm here, since he cannot purchase the fee-simple of it) hasteneth on his death by his unwary and rash use of meats, which poyson his blood : and then his infected blood passing through his whole body, must needs in like manner taint it all at once. For the redress of which mischief, the assistance of physick is made use of : and that passing likewise the same way, purifieth the blood, and recovereth the corruption occasioned by the peccant humour ; or other-whiles gathering it together, it thrusteth and carrieth out that evil guest, by the passages contrived by nature to disburden the body of unprofitable or hurtfull superfluities.

CHAP. XXVII.

Of the motions of sense ; and of the sensible qualities in general ; and in particular, of those which belong to Touch, Taste, and Smelling.

HAVING thus brought on the course of nature as high as living creatures (whose chief specieses or division is those that have sense) and having declared the operations which are common to the whole tribe of them which includeth both plants and animals ; it is now time we take a particular view of those, whose action and passion is the reason why that chief portion of life is termed sensitive ; I mean the senses, and the qualities, by which the outward world cometh into the living creature through his senses, Which when we shall have gone through, we

I.
The connexion of the subsequent chapters with the precedent.

we shall scarcely have left any qualities among bodies, to plead for a spiritual manner of being or working; that is, for a self-entity, and instantaneous operation: which kind of things and properties, vulgar Philosophy is very earnest to attribute unto our senses: with what reason, and upon what ground, let us now consider.

2. These qualities are reduced to five several heads, answerable to so many different waies, whereby we receive notice of the bodies that are without us. And accordingly, they constitute a like number of different senses: of every one of which, we will discourse particularly, when we have examined the natures of the qualities that affect them. But now, all the consideration we shall need to have of them, is onely this, That it is manifest the organs in us, by which sensible qualities do work upon us, are corporeal, and are made of the like ingredients as the rest of our body is: and therefore must of necessity be liable to suffer evil, and to receive good (in such sort as all other bodies do) from those active qualities which make and mar all things within the limits of nature. By which terms of Evil and Good, I mean those effects that are averse or conformable to the particular nature of any thing; and thereby do tend to the preservation or destruction of that individual.

Now we receiving from our senses the knowledge that we have of things without us, do give names unto them according to the passions and affections which those things cause in our senses: which being the same in all mankind (as long as they are considered in common, and that their effects are looked upon in gross) all the world agreeth in one notion, and in one name of the same thing; for every man living is affected by it, just as his neighbour is, and as all men else in the world are. As for example, heat or cold worketh the same feeling in every man composed of flesh and blood; and therefore whosoever should be asked of them would return the same answer, that they cause such and such effects in his sense, pleasing or displeasing to him, according to their degrees, and as they tend to the good or evil of his whole body.

But if we descend to particulars, we shall finde that several men of differing constitutions, do frame different notions of the same

same things, according as they are conformable or disagreeing to their natures: and accordingly they give them different names. As when the same liquor is sweet to some mens taste, which to anothers appeareth bitter: one man taketh that for a perfume, which to another is an offensive smell: in the Turkish baths; (where there are many degrees of heat in divers rooms, through all which the same person useth to pass, and to stay a while in every one of them, both at his entrance and going out, to season his body by degrees, for the contrary excess he is going unto) that seemeth chilly cold at his return; which appeared melting hot at his going in; as I my self have often made experience in those countreys. Beauty and loveliness will shine to one man in the same face, that will give aversion to another. All which proclaimeth, that the sensible qualities of bodies are not any positive real thing, consisting in an indivisible, and distinct from the body it self; but are meerly the very body, as it affecteth our senses: which to discover how they do it, must be our labour here.

Let us therefore begin with considering the difference that is between sensible and insensible creatures. These later do lie exposed to the mercy of all outward agents that from time to time (by the continual motion which all things are in) do come within distance of working upon them: and they have no power to remove themselves from what is averse to their nature; nor to approach neerer unto what comforteth it. But the other having within themselves a principle of motion (as we have already declared) whensoever such effects are wrought upon them, as upon the others; they are able upon their own account and by their own action, to remove themselves from what beginneth to annoy them, and to come neerer unto what they find a beginning of good by.

These impressions are made upon those parts of us, which we call the organs of our senses; and by them do give us seasonable advertisements and knowledges whereby we may govern and order to the best advantage, our little charge of a body, according to the tune or warnings of change in the great circumstant body of the world, as far as it may concern ours. Which how it is done, and by what steps it proceedeth, shall be in the following discourse laid open.

Of this great machine that environeth us, we who are but a small parcel, are not immediately concerned in every part of it. It importeth not us for the conservation of our body, to have knowledge of other parts than such as are within the distance of working upon us: those onely within whose sphere of activity we are placed, can offend or advantage us: and of them some are neer us, others farther from us. Those that are next unto us, we discern (according as they are qualified) either by our touch, or by our taste, or by our smelling; which three senses do manifestly appear to consist in a meer gradation of more or less gross; and their operations are levelled to the three elements that press upon us, earth, water, and air. By our other two senses (our hearing and our seeing) we have notice of things farther off: and the agents which work upon them, are of a more refined nature.

3. But we must treat of them all in particular: and that which of the sense of touching: and that both it and its qualities are bodies we will begin with shall be the touch; as being the grossest of them, and that which converseth with none but the most material and massie objects. We see it dealeth with heavy consistent bodies, and judgeth of them by conjunction unto them, and by immediate reception of something from them. And according to the divers impressions they make in it, it distinguisheth them by divers names; which (as we said of the qualities of mixed bodies) are generally reduced to certain pairs, as hot and cold, wet and dry, soft and hard, smooth and rough, thick and thin, and some others of the like nature; which were needless to enumerate, since we pretend not to deliver the science of them, but onely to shew that they and their actions are all corporeal.

And this is sufficiently evident, by meer repeating but their very names: for it is plain by what we have already said, that they are nothing else but certain affections of quantity, arising out of different degrees of rarity and density compounded together. And it is manifest by experience, that our sense receiveth the very same impressions from them which another body doth: for our body or our sense will be heated by fire; and will also be burned by it, if the heat be too great, as well as wood: it will be constipated by cold water, moistened by humid things, and dried by dry bodies, in the same manner as any other body what.

whatsoever; likewise, it may in such sort as they, be wounded and have its continuity broken by hard things; be pleased and polished by those that are soft and smooth; be pressed by those that are thick and heavy; and be rubbed by those that are rugged, &c.

So that those masters who will teach us that the impressions upon sense are made by spiritual or spirit-like things or qualities, which they call intentional specieses, must labour at two works: the one to make it appear that there are in nature such things as they would persuade us; the other, to prove that these material actions we speak of are not able to perform those effects, for which the senses are given unto living creatures. And until they have done that, I conceive we should be much too blame to admit such things, as we neither have ground for in reason, nor can understand what they are. And therefore we must resolve to rest in this belief, which experience breedeth in us; that these bodies work upon our senses no other waies than by a corporeal operation; and that such a one is sufficient for all the effects we see proceed from them: as in the process of this discourse we shall more amply declare.

The Element immediately next to earth in grossness, is water. And in it is the exercise of our taste, our mouth being perpetually wet within; by means of which moisture, our tongue receiveth into it some little parts of the substance which we chew in our teeth, and which passeth over it. You may observe how, if we take any herb or fruit, and having chopped or beaten it small, we then put it into a wooden dish of water and do squeeze it a little; the juice communicating and mingling it self with the water, infecteth it with the taste of it self, and remaining a while in the bowl, sinketh by little and little into the very pores of the wood: as is manifest by its retaining a long time after the taste and smell of that herb. In like manner, nature hath taught us by chewing our meat, and by turning it into our mouths and pressing it a little (that we may the more easily swallow it) to imbue our spittle with such little parts as easily diffuse themselves in water. And then our spittle being continue to the moisture which is within our tongue, (in such sort as we declared of the moisture of the earth that soaketh into the

4.

Of the taste and its qualities: that they are bodies.

root of a plant) and particularly in the sinews of it; must of necessity affect those little sensible strings with the qualities which these petty bodies, mixed every where with the moisture, are themselves imbued withall.

And if you ask what motions or qualities these be: Physicians (unto whom it belongeth most particularly to look into them) will tell you, that some dilate the tongue more, and some less; as if some of these little bodies had an aerial, and others a watry disposition: and these two they express by the names of sweet and fatty. That some do contract and draw the tongue together, as choaky and rough things do most; and next to them crabby and immature sharpness. That some do corrode and pierce the tongue, as salt and sowre things. That bitter things do search the outside of it, as if they swept it: and that other things do as it were prick it, as spices and hot drinks. Now all these are sensible material things, which admit to be explicated clearly, by the varieties of rarity and density concurring to their compositions; and are so proportionable to such material instruments as we cannot doubt but that they may be thoroughly declared by our former principles.

5. The next element above water is air, which our nostrile, That the smell and its qualities are real bodies. being our instrument to suck in, we cannot doubt but what affects a man by his nose, must come unto him in breath or air. And as humidity receiveth grosser and weightier parts, so those which are more subtile and light, do rise up into the air: and these we know attain unto this lightness by the commixtion of fire, which is hot and dry. And therefore we cannot doubt, but that the nature of smell is more or less tending to heat and drought: which is the cause that their commixtion with the brain, proveth comfortable unto it; because of its own disposition it is usually subject to be too moist and too cold.

Whether there be any immediate instrument of this sense, to receive the passion or effect, which by it other bodies make upon us; or whether the sense itself be nothing but a passage of these exhalations and little bodies unto the brain, fitly accommodated to discern what is good or hurtfull for it, and accordingly to move the body to admit or reject them, importeth not

not us at present to determine : let Physicians and Anatomists resolve that question, whiles it sufficeth us to understand that the operations of bodies by odours upon our sense, are performed by real and solid parts of the whole substance ; which are truly material, though very little bodies ; and not by imaginary qualities.

And those bodies, when they proceed out of the same things that yield also tastive particles, (although without such material violence, and in a more subtile manner) must of necessity have in them the same nature, which those have that affect the taste ; and they must both of them affect a man much alike, by his taste and by his smell : and so are very proportionate to one another ; excepting in those properties which require more cold or liquidity than can well stand with the nature of a smell. And accordingly, the very names which men have imposed to express the affections of both, do many times agree : as savour, which is common both to the smell and to the taste ; and sweet likewise : the strongest of which we see oftentimes do make themselves known as well by the one as by the other sense ; and either of them in excess will turn a mans stomack. And the Physicians that write of the senses finde them very conformable : and therefore it happeneth that the losing of one of them, is the loss also of the other.

6.
Of the conformity betwixt the two senses of smelling and tasting.

And experience teacheth us in all beasts, that the smell is given unto living creatures, to know what meats are good for them, and what are not. And accordingly we see them still smell for the most part at any unknown meat before they touch it ; which seldom faileth of informing them rightly : nature having provided this remedy against the gluttony, which could not choose but follow the convenient disposition and temper of their parts and humours ; through which they often swallow their meat greedily and suddenly, without expecting to try it first by their taste. Besides that, many meats are so strong, that their very tasting them after their usual manner, would poyson, or at the least greatly annoy them : and therefore nature hath provided this sense to prevent their taste ; which being far more subtile than their taste ; the small atoms by which it is performed are not so very noxious to the health of the animal, as the other grosser atoms are.

7.
The reason why the sense of smelling is, not so perfect in man as in beasts: with a wonderfull history of a man who could wind a sent as well as any beast.

And doubtlesly, the like use men would make of this sense, had they not on the one side better means than it to know the qualities of meats: and therefore, this is not much reflected upon. And on the other side, were they not continually stuffed and clogged with gross vapours of steamy meats, which are daily reeking from the table and their stomachs; and permit not purer atoms of bodies, to be discerned; which require clear and uninfected organes to take notice of them. As we see it fare with dogs; who have not so true and sensible noses, when they are high fed, and lie in the kitchen amidst the steams of meat; as when they are kept in their kenel, with a more spare diet, fit for hunting.

One full example, this age affordeth us in this kind, of a man, whose extremity of fear wrought upon him to give us this experiment. He was born in some village of the countrey of *Liege*: and therefore among strangers, he is known by the name of *John of Liege*. I have been informed of this story by several (whom I dare confidently believe) that have had it from his own mouth, and have questioned him with great curiosity, particularly about it.

When he was a little boy, there being wars in the countrey (as that State is seldome without molestations from abroad, when they have no distempers at home, which is an unseparable effect of a countries situation upon the frontiers of powerfull neighbouring Princes that are at variance) the village of whence he was, had notice of some unruly scattered troops that were coming to pillage them: which made all the people of the village flie hastily with what they could carry with them, to hide themselves in the woods: which were spacious enough to afford them shelter, for they joyned upon the Forrest of *Ardenne*. There they lay, till some of their secours brought them word, that the souldiers of whom they were in such apprehension, had fired their town and quitted it. Then all of them returned home, excepting this boy; who it seemeth, being of a very timorous nature, had images of fear so strong in his fantasie, that first, he ran farther into the wood than any of the rest; and afterwards apprehended that every body he saw through the thicket, and ev.ry voice he heard was the souldiers: and so hid himself from his

his parents that were in much distress seeking him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they returned home without him, and he lived many years in the woods, feeding upon roots, and wild fruits, and mast.

He said that after he had been some time in this wild habitation, he could by the smell judge of the taste of any thing that was to be eaten: and that he could at a great distance wind by his nose, where wholesome fruits or roots did grow. In this state he continued (still shunning men with as great fear as when he first ran away; so strong the impression was, and so little could his little reason master it) until in a very sharp winter, that many beasts of the forest perished for want of food, necessity brought him to so much confidence, that leaving the wild places of the forest, remote from all peoples dwellings, he would in the evenings steal among cattel that were sothered; especially the swine, and among them, glean that which served to sustain wretchedly his miserable life. He could not do this so cunningly, but that returning often to it, he was upon a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair) believing him to be a satyre, or some such prodigious creature as the recounters of rare accidents tell us of, laid wait to apprehend him. But he that winded them as far off, as any beast could do, still avoided them, till at length, they laid snares for him, and took the wind so advantageously of him, that they caught him: and then, soon perceived he was a man; though he had quite forgotten the use of all language: but by his gestures and cries, he expressed the greatest affrightedness that might be. Which afterwards he said (when he had learned anew to speak) was because he thought, those were the souldiers he had hidden himself to avoid, when he first betook himself to the wood; and were alwaies lively in his fantasie, through his fears continually reducing them thither.

This man within a little while after he came to good keeping and full feeding, quite lost that acuteness of smelling which formerly governed him in his taste; and grew to be in that particular as other ordinary men were. But at his first living with
other:

2 Of divers arts belonging to the sense of hearing : all which confirm that sound is nothing but motion. lileo hath delivered us the consonances of Musick towards the end of his first Dialogue of motion ; from the 95 page forward on : and how he hath shewed that matter cleerly unto the sight (so making the eye, as well as the ear judge of it) in motions of the water, in pendants hanging loose in the ayre, and in permanent notes or races made upon leron. To the moderation of the same, many other mechanicall arts are applied ; as the trade of bell-founders, and of all makers of musical instruments by wind, or by water, or by strings.

Neither can I slip over without mentioning the two curious arts of Echoing and of whispering. The first of which teacheth to iterate voyces several times ; and is frequently put in practice by those that are delighted with rarities in their gardens. And the other sheweth how to gather into a narrow roome the motions of the ayre, that are diffused in a great extent ; whereby, one that shall put his care to that place, where all the severall motions do meet, shall hear what is spoken so low, as no body between him, and the speaker, can discern any sound at all. Of which kind, there are very fine curiosities in some Churches of England : and my selfe have seen, in an upper room of a capacious round Tower vaulted overhead, the wals so contrived (by chance I beleieve) that two men standing at the utmost opposite points of the Diameter of it, could talke very currently and cleerly with one and other ; and yet none that stood in the middle could heare a syllable. And if he turned his face to the wall and spoke against that (though never so softly) the others eare, at the opposite point would discern every word. Which putteth me in mind of a note made by one that was no friend to auricular confession ; upon his occasion of his being with me in a Church that had been of a monestary ; where, in one corner of it, one might sit and heare almost all that was whispered through the whole extent of the Church : who would not be perswaded but that it was on purpose contrived so by the subtilty of the Friars ; to the end that the Prior or some one of them might sit there and hear whatsoever the severall Penitents accused themselves of to their ghostly fathers ; so to make advantage by this artifice, of what the confessors durst not of themselves immediately reveale.

He allowed better of the use in Rome of making voyces rebound

bound from the top of the cupula of St. Peters in the Vatican down to the floore of the Church; when on great daies they make a Quire of Musike goe up to the very highest part of the arch, which is, into the Lanthorn: from whence while they sing the people below just under it are surprized with the smart sound of their voice, as though they stood close by them, and yet can see no body from whom those notes should proceed. And in the same cupula, if two men stand upon the large cornice or bord, which circleth the bottom of it, they may observe the like effect, as that wick I spoke of above in the round Tower.

In the like manner, they that are called ventriloqui, do perswade ignorant people, that the devil speaketh frō within them (deep in their belly) by their sucking their breath inwards in a certain manner whiles they speake: whence it followeth, that their voice seemeth to come, not from them, but from somewhat else hidden within them; if (at the least) you perceive it cometh out of them: but if you do not, then it seemeth to come from a good way off.

To this art belongeth the making of Sarabatanes, or Trunks, to help the hearing; and of Echo glasses, that multiply sounds, as burning glasses do light. All which arts, and the rules of them do follow the laws of motion: and every effect of them is to be demonstrated by the principles and proportions of motion: and therefore, we cannot with reason imagine them to be any thing else.

We see likewise, that great noises not only offend the hearing, but even shake houses & Towers. I have been told by inhabitants of Dover, that when the Arch-Duke Albertus made his great battery against Calais (when for the time was a very furious one, for he endeavored all he could to take the town before it could be relieved) the very houses were shaken, & the glasse-windows were shivered, with the report of his Artillery. And I have been told by one that was in Sevil, when the gunpowder-house of that Town (which was some two miles distant from that place where he lived) was blown up, that it made the wooden shutters of the windows in his house, beat & clap against the walls with great violence, and did split the very wall of a faire Church, that standing next it (though at a good distance) had no other building betwene to shelter it from the

3.
The same is confirmed by the effects caused by great noises.

impetuosity of the ayres sudden violent motion.

And after a fight I once had with some Galleasses and Gallions in the rode of Scanderone (which was a very hot one for the time, and a scarce credible number of pieces of Ordnance were shot from my fleete) the English Consul of that place comming afterwards aboard my ship, told me that the report of our guns had during all the time of the fight shaken the drinking-glasses that stood upon the lves in his house; and had split the paper-windows all about; and had spoiled and cracked all the egges that his Pigeons were then sitting upon: which losse he lamented exceedingly; for they were of that kind, which commonly is called *Carriers*, & serve them daily in their commerce between that place and Aleppo.

And I have often observed at sea, in smooth water, that the Ordnance shot off in a ship some miles distant, would violently shake the glasse windows in another. And I have perceived this effect in mine owne, more then once, at the report of a single gun from a ship so far off, that we could not descry her. I remember how one time upon such an occasion, we altered our course and steared with the sound, or rather with the motion at the first, observing upon which point of the Compasse the shaking appeared (for we heard nothing; though soon after with much attention and silence we could discern a dull clumfie noise: and such a motion groweth at the end of it so faint, that if any strong resisting body checke it in its course, it is presently deaded, and wil afterwards shake nothing beyond that body: and therefore it is perceptible only at the outside of the ship, if some light & very moveable body do hang loosely on that side it cometh, to receive the impression of it; as this did at the gallery windows of my cabin upon the poop, which were of light Moscovia glasse or talk:) and by then we had run somewhat more then a watch, with all the sails abroad we could make, & in a fair loom gale, we found our selves neer enough to part the fray of two ships, that in a little while longer fighting would have sunk one another.

That solid bodies may convey the motion of the ayre or sound to the organs of hearing

But besides the motions in the ayre (which received them easily by reason of the fluidity of it) we see that even solid bodies do participate of it. As if you knock never so lightly at one end of the longest beam you can find, it will be distinctly hard at the other end: the trampling of men and horses in a quiet night will

be

be heard some miles off, if one lay their eare to the ground; and more sensibly if one make a little hole in the earth, and put ones eare into the mouth of it; but most of all if one set a Drum smooth upon the ground, and lay ones eare to the upper end of it; for the lower membrane of the Drum is shaken by the motion of the earth, and then multiplyeth that sound by the hollow figure of the Drum in the conveying it to the upper membrane, upon which your eare leaneth. Not much unlike the tympane or drum of the eare; which being shaken by outward motion, causeth a second motion on the inside of it correspondent to this first; and this having a free passage to the brain, striketh it immediately, and so informeth it how things move without; which is all the mystery of hearing.

5. If any thing doe break or stop this motion, before it shake our eare, it is nor heard. And accordingly we see that the sound of bells or artillery is heard much further if it have the conduct of waters, than through the pure ayr: because in such bodies the great continuity of them maketh that one part cannot shake alone, and upon their superficies, there is no notable unevenness, nor no dense thing in the way to check the motion (as in the ayr, hills, buildings, trees, & such like:) so that the same shaking goeth a great way. And to confirm that this is the true reason, I have several times observed, that standing by a river side, I have heard the sound of a ring of bells, much more distinctly and lowd, than if I went some distance from the water, though nearer to the steeple from whence the sound came.

Where the motion is interrupted there is no sound.

6. And it is not only the motion of the ayr, that maketh sound in our eares: but any motion that hath access to them in such a manner as to shake the quivering membranous tympane within them, will represent unto us those motions which are without, and so make such a sound there as if it were conveyed onely by the ayr. Which is plainly seen, when a man lying a good way under water, shall there hear the same sounds, as are made above in the ayr; but in a more clumisie manner; according as the water, by being thicker, and more corpulent, is more unwieldly in its motions. And this I have tried often; staying under water as long as the necessity of breathing would permit me. Which sheweth that the ayr being smartly moved, moveth the water also, by means of its continuity with it; and that li-

That not only the motion of the air, but all other motions coming to our ears make sounds.

7
How one sense
may supply
the want of an
other.

quid element, being fluid and getting into the eare, maketh vibrations upon the drum of it like unto those of ayr.

But all this is nothing in respect of what I might in some sort say, and yet speak truth. Which is, that I have seen one, who could discern sounds with his eyes. It is admirable, how one sense will oftentimes supply the want of another: whereof I have seen an other strange example in a different strain from this; of a man that by his grosser senses had his want of sight wonderfully made up. He was so thoroughly blind, that his eyes could not inform him when the Sun shined; for all the crystalline humour was out in both his eyes: yet his other senses instructed him so efficaciously in what was their office to have done; as what he wanted in them, seemed to be overpayed in other abilities. To say that he would play at cards and tables as well as most men, is rather a commendation of his memory and fanſie, than of any of his outward senses. But that he should play well at boules and shovelbord, and other games of aym, which in other men do require clear sight, and an exact levell of the hand according to the qualities of the earth or table, and to the situation and distance of the place he was to throw at, seemeth to exceed possibility: and yet he did all this.

He would walk in a chamber or long alley in a garden (after he had been a while used to them) as straight, and turn as just at the ends, as any seeing man could doe. He would go up and down every where so confidently, and demean himselfe at table so regularly, as strangers have sitten by him severall meals and have seen him walk about the house, without ever observing any want of seeing in him: which he endeavoured what he could to hide, by wearing his hat low upon his browes. He would, at the first abord of a stranger, as soon as he spoke to him, frame a right apprehension of his stature, bulk and manner of making. And which is more, when he taught his scholars to declame (for he was schoolmaster to my sonnes and lived in my house) or to represent some of Seneca's Tragedies, or the like, he would by their voice know their gesture, and the situation they put their bodies in: so that he would be able, as soon as they spoke, to judge whether they stood or sate, or in what posture they were; which made them demean themselves as decently before him whiles they spoke, as if he had seen them perfectly.

Though

Though all this be very strange, yet me thinks his discerning of light is beyond it all. He would feel in his body, and chiefly in his brain (as he hath often told me) a certain effect by which he did know when the Sun was up; and would discern exactly a clear from a cloudy day. This I have known him frequently do without missing, when for triall sake he hath been lodged in a close chamber, whereunto the clear light or Sun could not arrive to give him any notice by its actuall warmth; nor any body could come to him, to give him private warnings of the changes of the weather.

But this is not the relation I intended, when I mentioned one that could hear by his eyes; (if that expression may be permitted me) I then reflected upon a Noble man of great quality that I knew in Spain, the younger brother of the Constable of Castile. But the reflection of his seeing of words, called into my remembrance the other that felt light: in whom I have often remarked so many strange passages, with amazement and delight; that I have adventured upon the Readers patience to record some of them, conceiving they may be of some use in our course of doctrine. But the Spanish Lord was born deaf; so deaf, that if a Gun were shot off close by his ear, he could not hear it; and consequently, he was dumb, for not being able to hear the sound of words, he could never imitate nor understand them. The loveliness of his face, and especially the exceeding life and spiritfulness of his eyes, and the comeliness of his person, and whole composure of his body throughout, were pregnant signes of a well tempered mind within. And therefore all that knew him lamented much the want of meanes to cultivate it, and to imbrue it with the notions which it seemed to be capable of in regard of its self, had it not been so crossed by this unhappy accident. Which to remedy Physicians and Chirurgeons had long imployed their skill; but all in vain. At the last, there was a Priest who undertook the teaching him to understand others when they spoke, and to speak himself that others might understand him. What at the first he was laught at for, made him after some yeers be looked upon as if he had wrought a miracle. In a word; after strange patience, constancy and paines, he brought the young Lord to speak as distinctly as any man whosoever; and to understand so perfectly what

8

Of one who
could discern
sound of
words with
his eyes.

others said that he would not lose a word in a whole daies conversation.

They who have a curiosity to see by what steps the master proceeded in teaching him, may satisfie it by a book which he himself hath writ in Spanish upon that subject, to instruct others how to teach deaf and dumb persons to speak. Which when he shall have looked heedfully over, and shall have considered what a great distance there is between the simplicity and nakednesse of his first principles, and the strange readinesse and vast extent of speech resulting in proesse of time out of them; he will forbear pronouncing an impossibility in their pedigree, whiles he wondereth at the numerous effects resulting in bodies out of rarity and density, ingeniously mingled together by an all-knowing Architect, for the production of various qualities among mixts, of strange motions in particular bodies, and of admirable operations of life and sense among vegetables and animals. All which are so many several words of the mystical language, which the great master hath taught his otherwise dumb scholars (the creatures) to proclame his infinite art, wisdom, perfections, and excellency in.

The Priest who by his book and art occasioned this discourse, I am told is still alive, and in the service of the Prince of Carignan, where he continueth (with some that have need of his paines) the same imployment as he did with the Constables brother: with whom I have often discoursed, whiles I waited upon the Prince of Wales (now our gracious Sovereign) in Spain. And I doubt not but His Majesty remembreth all I have said of him, and much more: for His Majesty was very curious to observe and enquire into the utmost of it. It is true, one great misbecomingness he was apt to fall into whiles he spoke, which was an uncertainty in the tone of his voyce; for not hearing the sound he made when he spoke, he could not steadily govern the pitch of his voyce; but it would be sometimes higher, sometimes lower; though for the most part, what he delivered together, he ended in the same key as he began it. But when he had once suffered the passage of his voice to close, at the opening them again, chance, or the measure of his earnestnesse to speak or to reply, gave him his tone: which he was not capable of moderating by such an artifice, as is recorded Caius Gracchus used, when

when passion, in his orations to the people, drove out his voyce with too great a vehemence or shrillnesse.

He could discern in another, whether he spoke shrill or low: and he would repeat after any body, any hard word whatsoever. Which the Prince tryed often; not onely in English, but by making some Welchmen that served his Highnesse, speak words of their language. Which he so perfectly ecchoed, that I confesse I wondered more at that than at all the rest. And his Master himself would acknowledge, that the rules of his art reached not to produce that effect with any certainty. And therefore concluded, this in him must spring from other rules he had framed unto himself, out of his own attentive observation: which, the advantage that nature had justly given him in the sharpenesse of his other senses, to supply the want of this, endowed him with an ability and sagacity to do beyond any other man that had his hearing. He expressed it (surely) in a high measure, by his so exact imitation of the Welch pronunciation: for that tongue (like the Hebrew) employeth much the guttural Letters: and the motions of that part which frameth them cannot be seen nor judged by the eye, otherwise than by the effect they may happily make by consent in the other parts of the mouth, exposed to view: for the knowledge he had of what they said, sprung from his observing the motions they made; so that he could converse currently in the light, though they he talk'd with, whispered never so softly. And I have seen him at the distance of a large chambers breadth, say words after one, that I standing close by the speaker could not hear a syllable of. But if he were in the dark, or if one turned his face out of his sight, he was capable of nothing one said.

But it is time that we return to our theam, from whence my blind schoolmaster, and this deaf Prince (whose defects were overpayed an other way) have carried us with so long a digression. Which yet will not be altogether uselesse (no more than the former, of the wild man of Liege) if we make due reflections upon them: for when we shall consider, that odors may be tasted; that the relish of meats may be smelled; that magnitude and figure may be heard; that light may be felt; and that sounds may be seen; (all which is true in some sense) we may by this changing the offices of the senses, and by looking

9
Divers reasons
to prove sound
to be nothing
else but a mo-
tion of some
reall body.

into

into the causes thereof ; come to discern that these effects are not wrought by the intervention of aery qualities ; but by reall and materiall applications of bodies to bodies ; which in different manners do make the same results within us.

But when I offered my pen to be steered by my fanſie, that pleased it self, and rioted in the remembrance of these two notable persons : I was speaking, how the strong continuity of the parts of a thing that is moved, draweth on the motion, and consequently the sound, much further than where that which is moved suffereth breaches, or the rarity of it occasioneth that one part may be moved without an other ; for to the proportion of the shaking, the noise continueth. As we see in trembling bells ; that hum a great while longer than others, after the Clapper hath stricken them : and the very sound seemeth to quiver and shake in our eares, proportionable to the shaking of the bell. And in a Lute as long as a string that hath been stricken, shaketh sensibly to our eye ; so long and to the same measure, the sound shaketh in our eare. Which is nothing else but an undulation of the Ayre, caused by the smart and thick vibrations of the cord, and multiplied in the belly of the instrument (which is the reason that the concave figure is affected in most) and so when it breaketh out of the instrument in greater quantity, than the string immediately did shake ; it causeth the same undulations in the whole body of Ayre round about. And that, striking the Drum of the eare, giveth notice therein what tenour the string moveth : whose vibrations if one stop by laying his finger upon it, the sound is instantly at an end, for then there is no cause on foot, that continueth the motion of the Ayre ; which, without a continuation of the impulse, returneth speedily to quiet ; through the resistance made unto it, by other parts of it that are further off.

Out of all which it is plain, that motion alone is able to effect and to give account of all things whatsoever that are attributed to sound ; and that sound and motion, do go hand in hand together ; and that whatsoever is said of the one is likewise true of the other. Wherefore it cannot be denied, but that *hearing* is nothing else but the due perception of *motion* : and that *motion* and *sound* are in themselves one and the same thing, though expressed by different names, and comprised in our understanding

derstanding under different notions. Which proposition seemeth to be yet further convinced, by the ordinary experience of perceiving musick by mediation of a stick; for how should a deaf man be capable of musick by holding a stick in his teeth, whose other end lyeth upon the Viall or Virginalls, were it not that the proportionall shaking of the stick (working a like dauncing in the mans head) did make a like motion in his brain, without passing through his eare? and consequently, without being otherwise *sound*, than as bare motion is *sound*.

Or if any man will still persist in having sound be some other thing than as wee say; and that it affecteth the sense otherwise than purely by motion: hee must nevertheless acknowledge, that whatsoever it be, it hath neither cause nor effect, nor breeding, nor dying, that we either know or can imagine: and then, if he will let reason sway, hee will conclude it unreasonable to say or suspect so ill-grounded a surmise, against so clear and solid proofs, which our eares themselves do not a little confirm; their whole figure and nature tending to the perfect receiving, conserving, and multiplying the motions of ayre which happen without a man: as who is curious, may plainly see in the Anatomists books and discourses.

THE NINE AND TWENTIETH CHAPTER.

Of Sight, and Colours.

THERE is yet left, the object of our sight, which we call *colours*, to take a survey of; for as for *light*, wee have at large displayed the nature and properties of it: from which whether colour be different or no, will be the question we shall next discusse: for those who are cunning in Opticks, will by refractions and by reflexions make all sorts of colours out of pure light: as we see in Rainbows, in those triangular glasses, or prismes which some do call *fooles Paradises*, and in other inventions for this purpose. Wherefore in brief, to shew what colour is, let us lay for a ground, that light is of all other things in the world, the greatest and the most powerfull agent upon our eye, either by it self, or by what commeth in with it: and that,

I.
That colours are nothing but light mingled with darknesse; or the disposition of a bodies superficies apt to reflect light so mingled.

that, where light is not, darknesse is ; then consider, that light being diversly to be cast, but especially, through or from a transparent body, into which it sinketh in part, and in part it doth not ; and you will conclude, that it cannot choose but come out from such a body in divers sorts mingled with darknesse : which if it be in a sensible quantity, doth accordingly make divers appearances : and those appearances must of necessity have divers hues, representing the colours which are middle colours between white and black ; since white is the colour of light, and darknesse seemeth black. Thus, those colours are ingendred, which are called apparent ones. And they appear sometimes but in some one position ; as the Rainbow ; which changeth place as the looker on doth : but at other times, they may be seen from any part ; as those which light maketh by a double refraction through a triangular glasse.

And that this is rightly delivered, may be gathered out of the conditions requisite to their production: for that crystal, or water, or any refracting body, doth not admit light in all its parts, is evident, by reason of the reflection that it maketh, which is exceeding great: and not onely from the superficies, but even from the middle of the body within: as you may see plainly, if you put it in a dark place, and enlighten but one part of it: for then, you may perceive, as it were, a current of light passe quite through the body, although your eye be not opposite to the passage: so that, manifestly it reflecteth to your eye, from all the inward parts which it lighteth upon.

Now a more oblique reflection or refraction doth more disperse the light, and admitteth more privations of light in its parts, than a lesse oblique one: as Galileo hath demonstrated in the first Dialogue of his systeme. Wherefore, a lesse oblique reflection or refraction, may receive that in quality of light, which a more oblique one maketh appear mingled with darknesse; and consequently, the same thing will appear colour in one, which sheweth it self plain light in the other; for the greater the inclination of an angle is, the greater also is the dispersion of the light.

And as colours are made in this sort, by the medium through which light passeth, so if we conceive the superficies from which the light reflecteth, to be diversly ordered in respect of reflexi-

on;

on ; it must of necessity follow that it will have a divers lustre and sight, as we see by experience in the necks of Pigeons, and in certain positions of our eye, in which the sight passing through our eye brows, maketh an appearance as though we saw divers colours streaming from a candle we look upon. And accordingly we may observe how some things, or rather most, do appear of a colour more inclining to white, when they are irradiated with a great light, then when they stand in a lesser. And we see Painters heighten their colours, and make them appeare lighter by placing deep shadows by them : even so much, that they will make objects appeare neerer and further off, meerly by the mixtion of their colours. Because objects, the neerer they are, the more strongly and lively they reflect light, and therefore appeare the clearer, as the others do more dusky.

Therefore, if we put the superficies of one body to have a better disposition for the reflection of light, then another hath ; we cannot but conceive, that such difference in the superficies, must needs beget variety of permanent colours in the bodies. And according as the superficies of the same body, is better, or worse disposed to reflection of light, by polishing or by compressure together, or the like : so, the same body, remaining the same in substance, will shew it selfe of a different colour. And it being evident that white (which is the chiefeest colour) doth reflect most light : and as evident, that black reflecteth least light ; so that it reflecteth shadowes in lieu of colours (as the Obsidian stone among the Romans doth witnesse) And it being likewise evident, that to be dense and hard, and of small parts, is the disposition of the object which is most apt to reflect light : we cannot doubt, but that *white* is that disposition of the superficies. That is to say, it is the superficies, of a body consisting of dense, of hard and of small parts ; and on the contrary side, that black is the disposition of the superficies, which is most soft and full of greatest pores ; for when light meeteth with such a superficies, it getteth easily into it ; and is there, as it were absorpt and hidden in caves, and commeth not out againe to reflect towards our eye.

This doctrine of ours of the generation of colours, agreeth exactly

2.
Concerning
the disposition
of these bodies
which produce
white or black
colours.

3
The former
doctrine con-
firmed by Ari-
stotles au-
thority, reason,
& experience.

exactly with *Aristotles* principles, and followeth evidently out of his definitions of *light*, and of *colours*. And for summing up the general sentiments of mankind in making his Logically definitions, I think no body will deny his being the greatest Master that ever was. He defineth light to be *actus Diaphani*: which we may thus explicate. It is that thing, which maketh a body that hath an aptitude or capacity of being seene quite through it in every interior part of it, to be actually seene quite through, according to that capacity of it. And he defineth colour to be, *The terme or ending of a diaphanous body*: the meaning whereof is: that colour is a thing which maketh a diaphanous body to reach no further; or that colour is the cause why a body is no further diaphanous, then untill where it beginneth; or that colour is the reason, why we can see no further then to such a degree, through or into such a body,

Which definition fitteth most exactly with the thing it giveth us the nature of. For it is evident, that when we see a body, the body we see hindreth us from seeing any other, that is in a straight line beyond it. And therefore it cannot be denyed, but that colour terminateth, and endeth the diaphaneity of a body, by making it selfe be seene. And all men do agree in conceiving this to be the nature of colour; and that it is a certaine disposition of a body, whereby that body commeth to be seene. On the other side, nothing is more evident, then that to have us see a body, light must reach from that body to our eye. Then adding unto this what *Aristotle* teacheth concerning the production of seeing: which he saith is made by the action of the seene body upon our sense: it followeth, that the object must work upon our sense, either by light, or at the least with light: for light rebounding from the object round about by straight lines, some part of it must needs come from the object to our eye. Therefore, by how much an object sendeth more light unto our eye, by so much, that object worketh more upon it.

Now seeing that divers objects do send light in divers manners to our eye, according to the divers natures of those objects in regard of hardnesse, densitty, and littlenesse of parts: we must agree that such bodies do work diversly, and do make different motions or impressions upon our eye: & consequently

ly, the passion of our eye from such objects must be divers. But there is no other diversity of passion in the eye from the object in regard of seeing, but that the object appear divers to us in point of colour. Therefore we must conclude, that divers bodies (I meane divers or different, in that kind we here talke of) must necessarily seem to be of divers colours, neerly by the sending of light unto our eye in divers fashions. Namely, the very same object may appear of different colours, whensoever it happeneth that it reflecteth light differently to us. As we see in cloth, if it be gathered together in fouldes, the bottomes of those fouldes shew to be of one kind of colour, and the tops of them, or where the cloth is stretched out to the full percussio[n] of light, it appeareth to be of another much brighter colour. And accordingly painters are faine to use almost opposite colours to expresse them. In like manner, if you look upon two pieces of the same cloth, or plush, whose graines lye contrawise to one another, they will likewise appeare to be of different colours. Both which accidents, and many others like unto them in begetting various representations of colours, do all of them arise out of lights being more or lesse reflected from one part then from another.

Thus then you see, how colour is nothing else, but the disposition of a bodies superficies, as it is more or less apt to reflect light; thence the reflection of light is made from the superficies of the seen body, & the variety of its reflexion begetteth variety of colours. But a superficies is more or lesse apt to reflect light, according to the degrees of its being more or lesse penetrable by the force of light striking upon it; for those rayes of light that gaine no entrance into a body they are darred upon, must of necessity fly back againe from it. But if light doth get enterance and penetrate into the body, it either passeth quite through it; or else it is swallowed up & lost in that body. The former constitute a diaphanous body; as we have already determined And the semblance which the latter wil have in regard of colour, we have also shewed must be black.

But let us proceede a little further. We know that two things render a body penetrable, or easie to admit another body into it. Holes, (such as we call pores) & softness or humidity; so that drynesse, hardnesse, and compactednesse, must be the properties

4
How the diversity of colours do follow out of various degrees of rarity and densi.y.

properties which render a body impenetrable. And accordingly we see, that if a diaphanous body (which suffereth light to run through it) be much compressed beyond what it was ; as when water is compressed into yce ; it becometh more visible, that is, reflecteth more light : and consequently, it becometh more white ; for white is that which reflecteth most light.

On the contrary side, softnesse, unctuousnesse, and viscosnesse, encreaseth blacknesse : as you may experience in oyling or in greasing of wood ; which before was but brown, for thereby it cometh more black ; by reason that the unctuous parts added unto the other, do more easily then they single, admit into them the light that striketh upon them ; and when it is gotten in, it is so entangled there (as though the wings of it were birdlimed over) that it cannot fly out againe. And thus it is evident, how the origine of all colours in bodies, is plainly deduced out of the various degrees of rarity and density, variously mixed and compounded.

5.
Why some bodies are Diaphanous, others opacous.

Likewise, out of this discourse, the reason is obvious why some bodies are diaphanous and others are opacous : for since it falleth out in the constitution of bodies that one is composed of greater parts then another: it must needs happen that light be more hindred in passing through a body composed of bigger parts, then an other whose parts are lesse. Neither doth it import that the pores be supposed as great as the parts, for be they never so large, the corners of the thicke parts they belong unto, must needs break the course of what will not bow, but goeth all in straight lines ; more then if the parts and pores were both lesser ; since, for so subtile a piercer as light, no pores can be too little to give it entrance. It is true such great ones would better admit a liquid body into them, such a one as water or ayre ; but the reason of that is, because they will bow and take any ply, to creep into those cavities, if they be large enough, which light will not do.

Therefore it is cleare, that freedome of passage can happen unto light, only there, where there is an extreame great multitude of pores and parties in a very little quantity or bulke of body (which pores and parts most consequently be extreame little ones) for, by reason of their multitude, there must be great variety in their situation : from whence it will happen that many

many lines must be all of pores quite through; and many others all of parts; although the most will be mixed of both pores and parts. And so we see that although the light do passe quite through in many places, yet it reflecteth from more, not onely in the superficies, but in the very body it self of the Diaphanous substance. But in another substance of great parts, and pores, there can be but few whole lines of pores, by which the light may passe from the object to make it be seen, and consequently it must be opacous; which is the contrary of Diaphanous that admitteth many rayes of light, to passe through it from the object to the eye, whereby it is seen, though the Diaphanous hard body do intervene between them.

Now if we consider the generation of these two colours (white and black) in bodies, we shall finde that likewise to justify and second our doctrine: for white things are generally cold and dry: and therefore are by nature ordained to be receptacles, and conservers of heat, and of moysture; as Physicians do note. Contrariwise, black, as also green, (which is near of kin to black) are growing colours, and are the die of heat incorporated in abundance of wet: as we see in smoak, in pitcoal, in garden ground, and in chymicall putrefactions all which are black; as also in yong herbs; which are generally green as long as they are yong and growing. The other colours keeping their standing betwixt these are generated by the mixture of them; and according as they partake more or lesse of either of them, are nearer or further off from it.

6
The former
doctrine of co-
lours confirm-
ed by the gene-
ration of white
and black in
bodies.

So that after all this discourse, we may conclude in short, that the colour of a body, is nothing else, but the power which that body hath of reflecting light unto the eye, in a certain order and position: and consequently, is nothing else but the very superficies of it, with its asperity, or smoothnesse; with its pores, or inequalities; with its hardnesse, or softnesse; and such like. The rules and limits whereof, if they were duly observed and ordered, the whole nature and science of colours would easily be known and be described. But out of this little which we have delivered of this subject it may be rightly inferred that real colours do proceed from rarity and density, (as even now we touched) and have their head & spring there: and are not strange

qualities in the Ayr : but are tractable bodies on the earth, as all others are, which as yet we have found and have meddied withall : and are indeed, the very bodies themselves, causing such effects upon our eye by reflecting of light, which we expresse by the names of colours.

THE THIRTIETH CHAP.

Of luminous or apparent Colours.

Apparitions
of colours
through a
prisme or tri-
angular glasse
are of two
sorts.

AS for the luminous colours, whose natures art hath made more maniable by us, than those which are called reall colours, and are permanent in bodies, their generation is clearly to be seen in the prisme or triangular glasse we formerly mentioned. The considering of which, will confirm our doctrin, that even the colours of bodies, are by various mixtures of light and shadowes, diversly reflected to our eyes. For the right understanding of them, we are to note, that this glasse maketh apparitions of colours in two sorts : the one, when looking through it there appear various colours in the objects you look upon (different from their reall ones) according to the position you hold the glasse in when you look upon them. The other sort is, when the beames of light that passe through the glasse are as it were tinted in their passage, and are cast by the glasse upon some solid object, and do appear there in such and such colours, which do continue still the same, in what position soever you stand to look upon them; either before, or behind, or any side of the glasse.

The severall
parts of the ob-
ject make se-
veral angles at
the entrance
into the
prisme.

Secondly, we are to note that these colours are generally made by refraction (though sometimes it may happen otherwise, as above we have mentioned.) To discover the reason of the first sort of colours, that appear by refraction when one looketh through the glasse : let us suppose two severall bodies, the one black, the other white, lying close by one an other, and in the same horizontall parallel ; but so, that the black be further from us than the white ; then, if we hold the prisme through which we are to see these two oppositely coloured bodies some-
what

what above them ; and that side of it at which the coloured bodies must enter into the glasse to come to our eye, parallele unto those bodies ; it is evident, that the black will come into the prisme by lesser angles than the white : I mean that in the line of distance from that face of the glasse at which the colours do come in, a longer line or part of black will subtend an angle, no bigger than a lesser line or part of white doth subtend.

Thirdly, we are to note, that from the same point of the object, there come various beames of light to that whole superficies of the glasse ; so that it may, and sometimes doth happen, that from the same part of the object, beams may be refl. &c. to the eye, from severall parts of that superficies of the glasse at which they enter. And whensoever this happeneth, the object must necessarily be seen in divers parts : that is, the picture of it will at the same time appear to the eye in divers places. And particularly, we may plainly observe two pictures, one a lively & strong one, the other a faint and dim one. Of which the dim one will appear neerer us, than the lively one (and is caused by a secondary ray : or rather I should say, by a longer ray, that striking neerer to the hitber edge of the glasses superficies (which is the furthest from the object) maketh a more acute angle than a shorter ray doth, that striketh upon a part of the glasse further from our eye, but neerer the object. And therefore the image which is made by this secondary or longer ray, must appear both neerer and more dusky, than the image made by the primary and shorter ray. And the further from the object that the glasse through which it reflecteth is situated (keeping still in the same parallele to the horizon) the further the place where the second dusky picture appeareth, is from the place where the primary strong picture appeareth.

If any man have a mind to satisfy himself by experience of the truth of this note, let him place a sheet of white paper upon a black carpet covering a table, so as the paper may reach within two or three fingers of the edge of the carpet, (under which, let there be nothing to succeed the black of the carpet, but the empty dusky Ayre) and then let him set himself at a convenient distance, (the measure of which is, that the paper appear at his feet, when he looketh through the glasse) and

3.

The reason why sometimes the same object appeareth through the prisme in two places : & in one place more lively, in the other place more dim.

look at the paper through his prisme situated in such sort as we have above determined, and he will perceive a whitish or light-some shadow proceed from the lively picture that he seeth of white, and shoot out neerer towards him than that lively picture is, and he will discern that it commeth into the glasse through a part of it neerer to his eye or face, and further from the object than the strong image of the white doth. And further, if he causeth the neerer part of the paper to be covered with some thin body of a sadder colour, this dim white vanisheth: which it doth not if the further part of the paper be covered. Whereby it is evident, that it is a secondary image proceeding from the hither part of the paper.

4.
The reason
of the vari-
ous colours
that appear
in looking
through a
prisme.

Now then to make use of what we have said to the finding out of the reason why the red and blew and other colours appear when one looketh through a prisme: let us proceed upon our former example, in which a white paper lyeth upon a black carpet (for, the diametrall opposition of those colours, maketh them most remarkable) in such sort that there be a parcel of black on the hither side of the paper: and therein let us examine according to our grounds, what colours must appear at both ends of the paper looking upon them through the triangular glasse.

To begin with the furthest end, where the black lyeth beyond the white: we may consider, how there must come from the black, a secondary dark misty shadow (besides the strong black that appeareth beyond the paper) which must shoot towards you (in such sort as we said of the whitish light-some shadow) and consequently, must ly over the strong picture of the white paper: now in this case, a third middling colour must result out of the mixture of these two extremes of black & white; since they come to the eye, almost in the same line, at the least in lines that make so little a difference in their angles as it is not discernable.

The like whereof happeneth in Cloaths, or Stuffs, or Stockings, that are woven of divers coloured but very small threds: for if you stand so far off from such a piece of Stuff, that the little threds of different colours which lye immediate to one another may come together as in one line to your eye; it will appear of a middling colour, different from both those that it resulteth

resulteth from : but if you stand so neer that each thred sendeth rayes enough to your eye, and that the basis of the triangle which commeth from each thred to your eye, be long enough to make at the vertex of it (which is in your eye) an angle big enough to be seen singly by it self, then each colour will appear a part as it truly is.

Now the various natures of middling colours we may learn of Painters ; who compose them upon their palettes by a like mixture of the extremes. And they tell us, that if a white colour prevail strongly over a dark colour, reds and yellows result out of that mixture : but if black prevail strongly over white, then blews, violets, and sea-greens are made. And accordingly, in our case, we cannot doubt but that the primary lively picture of the white, must prevail over the faint dusky sable mantle with which it commeth mingled to the eye : and doing so, it must needs make a like appearance as the Suns beams do, when reflecting from a black cloud, they fringe the edges of it with red and with yellow ; and the like he doth, when he looketh through a rainy or a windy cloud : and much like hereunto, we shall see this mixture of strong white with a faint shadow of black, make at this brim of the paper, a fair ledge of red ; which will end and vanish, in a more lightsome one of yellow.

But at the hither edge of the paper, where the secondary weak picture of white is mingled with the strong black picture, in this mixture, the black is prevalent, and accordingly (as we said of the mixture of the Painters colours) there must appear at the bottome of the paper a Lembe of deep blew : which will grow more and more lightsome, the higher it goeth : and so, passing through violet and sea-green it will vanish in light, when it reacheth to the mastering field of primary whitenesse, that sendeth his stronger rayes by direct lines : and this transposition of the colours at the severall ends of the paper sheweth the reason why they appear quite contrary, if you put a black paper upon a white carpet. And therefore, we need not add any thing particularly concerning that.

And likewise, out of this we may understand, why the colours appear quite contrary (that is, red where before blew appeared ; and blew, where red) if wee look upon the same

5.
The reason
why the prism
in one position,
may make the
colours appear
quite contrary
to what they did,
when it was in
an other position.

object through the glasse in an other position or situation of it. namely, if we raise it so high, that we must look upwards to see the object; which thereby appeareth above us: whereas in the former situation, it came in through the lower superficies, and we looked down to it, and it appeared under us: for in this second case, the objects coming into the glasse by a superficies, not parallel as before, but sloaping, from the objectwards; it followeth, that the neerer the object is, the lesser must the angle be, which it maketh with the superficies; contrary to what happened in the former case: and likewise, that if from one point of the neerer object, there fall two rayes upon the glasse, the ray that falleth uppermost, will make a lesser angle, than the other that falleth lower: and so, by our former discourse, that point may come to appear in the same place with a point of the further object; and thereby make a middling colour.

So that in this case, the white which is neerer, will mingle his feeble picture with the black that is further off: whereas before the black that was further off, mingled his feeble shadow with the strong picture of the neerer white. Wherefore by our rule we borrowed of the Painters, there will now appear a blew on the further end of the paper, where before appeared a red; and by consequence on the neerer end a red will now appear, where in the former case a blew appeared. This case we have chosen, as the plainest to shew the nature of such colours: out of which, he that is curious, may derive his knowledge to other cases which we omit; because our intent is onely to give a generall doctrine, and not the particulars of the Science: and rather to take away admiration, than to instruct the Reader in this matter.

6.
The reason
of the various
colours in general
by pure light passing
through a
prisme.

As for the various colours, which are made by straining light through a glasse, or through some other Diaphanous body; to discover the causes and variety of them, we must examine what things they are that do concur to the making of them: and what accidents may arrive unto those things, to vary their product. It is clear, that nothing interveneth or concurrerth to the producing of any of these colours, besides the light it self which is dyed into colour, and the glasse or Diaphanous body through which it passeth. In them therefore, and in nothing else, we are to make our enquiry.

To begin then, we may observe, that light passing through a prisme, and being cast upon a reflecting object, is not alwayes colour; but in some circumstances it still continueth light, and in others it becommeth colour. Withall we may observe, that those beames which continue light, and endure very little mutation by their passage, making as many refractions, do make much greater deflexions from the straight lines by which they came into the glasse, than those rayes do which turn to colour; as you may experience, if you oppose one surface of the glasse prependicularly to a Candle, and set a paper (not irradiated by the candle) opposite to one of the other sides of the glasse: for upon the paper, you shall see fair light shine without any colour; and you may perceive, that the line by which the light commeth to the paper, is almost prependicular to that line by which the light commeth to the Prisme. But when light becommeth colour, it striketh very obliquely upon the side of the glasse; and commeth likewise, very obliquely out of the other, that sendeth it in colour upon a reflectent body; so that in conclusion, there is nothing left us whereupon to ground the generation of such colours, besides the littlenesse of the angle and the sloapingness of the line, by which the illuminant striketh one side of the glasse, and commeth out at the other, when colours proceed from such a percussio.

To this then we must wholly apply our selves: and knowing that generally, when light falleth upon a body with so great a sloaping or inclination, so much of it as getteth through, must needs be weak and much diffused; it followeth that the reason of such colours, must necessarily consist in this diffusion and weakenesse of light; which the more it is diffused, the weaker it groweth, and the more lines of darkness are between the lines of light, and do mingle themselves with them.

To confirm this you may observe, how just at the egress from the prisme of that light which going on a little further becommeth colours, no colour at all appeareth upon a paper opposed close to the side of the glass; until removing it further off, the colours begin to shew themselves upon the edges: thereby convincing manifestly, that it was the excesse of light which hindered them from appearing at the first. And in like manner, if you put a burning glasse between the light and the prisme,

so as to multiply the light which goeth through the prisme to the paper, you destroy much of the colour by converting it into light. But on the other side, if you thicken the ayr, and make it dusky with smoak, or with dust, you will plainly see, that where the light commeth through a convex glasse (perpendicularly opposed to the illuminant) there will appear colours on the edges of the cones that the light maketh: and peradventure the whole cones would appear coloured if the darkening were conveniently made: for if an opacous body be set within either of the cones, its sides will appear coloured, though the ayr be but moderately thickned: which sheweth that the addition of a little darknesse, would make that which otherwise appeareth pure light, be thoroughly dyed into colours. And thus you have the true and adequate cause of the appearance of such colours.

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Upon what
side every co-
lour appeareth
that is made
by pure light
passing thorow
a prism.
Now, to understand what colours, and upon which sides, will appear: we may consider, that when light passeth through a glasse, or other diaphanous body, so much of it as shineth in the ayr, or upon some reflecting body bigger than it self, after its passage through the glasse, must of necessity have darknesse on both sides of it; and so be compriled and limited by two darknesse: but if some opacous body, that is lesse than the light, be put in the way of the light, then it may happen contrariwise, that there be darknesse (or the shadow of that opacous body) between two lights.

Again, we must consider, that when light falleth so upon a prisme as to make colours, the two outward rayes which proceed from the light to the two sides of the superficies at which the light entereth, are so refracted, that at their comming out again through the other superficies, that ray which made the lesse angle with the outward superficies of the glasse, going in, maketh in the greater angle with the outside of the other superficies, comming out: and contrariwise, that ray which made the greater angle, going in, maketh the lesser at its comming out: and the two internall angles, made by those two rayes, and the outside of the superficies they issue at, are greater than two right angles: and so we see that the light dilateth it self at its comming out.

Now because rayes that issue through a superficies, the nearer they

they are to be perpendiculars unto that superficies, so much the thicker they are: it followeth, that this dilatation of light at its coming out of the glasse, must be made and must increase from that side where the angle was least at the going in, and greatest at the coming out: so that the nearer to the contrary side you take a part of light, the thinner the light must be there, and contrariwise, the thicker it must be, the nearer it is unto the side where the angle at the rayes coming out is the greater. Wherefore, the strongest light, (that is, the place where the light is least mixed with darknesse) must be nearer that side than the other. Consequently hereunto, if by an opacous body you make a shadow comprehended within this light, that shadow must also have its strongest part, nearer unto one of the lights betwixt which it is comprised, than unto the other: for, shadow being nothing else, but the want of light, hindred by some opacous body; it must of necessity lie averfed from the illuminant, just as the light would have lain if it had not been hindred. Wherefore, seeing that the stronger side of light, doth more impeach the darknesse, than the feebler side doth; the deepest dark must incline to that side, where the light is weakest; that is, towards that side on which the shadow appeareth, in respect of the opacous body, or of the illuminant, and so be a cause of deepnesse of colour on that side, if it happen to be fringed with colour.

THE ONE AND THIRTIETH CHAPTER.

The causes of certain apparances in luminous colours; with a conclusion of the discourse touching the senses and the sensible qualities.

OUt of these grounds we are to seek the resolution of all such symptoms as appear unto us in this kind of colours. First therefore calling to mind, how we have already declared, that the red colour is made by a greater proportion of light mingled with darknesse, and the blew with a lesse proportion: it must follow, that when light passeth through a glasse in a prism. such sort as to make colours, the mixture of the light and darknesse on that side where the light is strongest will encline to a red:

^I The reason of each severall colour in particular caused by light passing through

red: and their mixture on the other side, where the light is weakest, will make a violet or blew: and this we see to fall out accordingly, in the light which is tinged by going through a prisme; for a red colour appeareth on that side from which the light doth dilate or encrease, and a blew is on that side towards which it decreaseth.

Now if a dark body be placed within this light, so as to have the light come on both sides of it, we shall see the contrary happen about the borders of the picture or shadow of the dark body: that is to say, the red colour will be on that side of the picture which is towards or over against the blew colour that is made by the glasse: and the blew of the picture will be on that side which is towards the red that is made by the glasse, as you may experience if you place a slender opacous body along the prisme in the way of the light, either before or behind the prisme. The reason whereof is, that the opacous body standing in the middle, environed by light, divideth the light, and maketh two lights of that which was but one; each of which lights is comprised between two darkneses, to wit, between each border of shadow that joyneth to each extream of the light that cometh from the glasse, and each side of the opacous bodies shadow. Wherefore, in each of these lights, or rather in each of their mixtions with darknesse, there must be red on the one side and blew on the other; according to the course of light which we have explicated.

And thus it falleth out, agreeable to the rule we have given, that blew commeth to be on that side of the opacous bodies shadow on which the glass casteth red, and red on that side of it on which the glass casteth blew: likewise when light going through a convexe glasse maketh two cones, the edges of the cone betwixt the glasse and the point of concourse will appear red, if the room be dark enough: and the edges of the further cone, will appear blew, both for the reason given: for in this case the point of concourse is the strong light betwixt the two cones: of which, that betwixt the glasse and the point is the stronger, that beyond the point the weaker: and for this very reason, if an opacous body be put in the axis of these two cones, both the sides of its picture will be red, if it be held in the first cone which is next to the glass; and both will be blew if the body be situated
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in the further cone ; for both sides being equally situated to the course of the light, within its own cone, there is nothing to vary the colours, but onely the strength and the weaknesse of the two lights of the cones, on this side and on that side the point of concurrence : which point, being in this case the strong and clear light whereof we made generall mention in our precedent note, the cone towards the glasse and the illuminant, is the stronger side, and the cone from the glasse, is the weaker.

In those cases, where this reason is not concerned, we shall see the victory carried in the question of colours, by the shady side of the opacous body: that is, the blew colour wil still appear on that side of the opacous bodies shadow that is furthest from the illuminant. But where both causes do concur and contrast for precedence, there the course of the light carrieth it : that is to say, the red will be on that side of the opacous bodies shadow where it is thicker and darker, and blew on the other side where the shadow is not so strong ; although the shadow be cast that way that the red appeareth : as is to be seen, when a slender body is placed betwixt the prisme and the reflectent body, upon which the light and colours are cast through the prisme : and it is evident, that this cause of the course of the shadow, is in it self a weaker cause, than the other of the course of light, and must give way unto it whensoever they encounter (as it cannot be expected, but that in all circumstances, shadows should be light) because the colours which the glasse casteth in this case, are much more faint and dusky than in the other.

For effects of this latter cause, we see that when an opacous body lyeth cross the prisme, whiles it standeth end-wayes, the red or blew colour will appear on the upper or lower side of its picture, according as the illuminant is higher or lower than the transverse opacous body : the blew ever keeping to that side of the picture, that is furthest from the body, and the illuminant that make it : and the red the contrary ; likewise if an opacous body be placed out of the axis, in either of the cones we have explicated before, the blew wil appear on that side of the picture which is furthest advanced in the way that the shadow is cast : and the red, on the contrary : and so, if the opacous body be placed in the first cone (beside the axis) the red will appear on that side of the picture in the basis of the second cone, which
is

is next to the circumference ; and the blew, on that side which is next the axis : but if it be placed on one side of the axis in the second cone, then the blew will appear on that side the picture which is next the circumference, and the red, on that side which is next the center of the basis of the cone.

2.
A difficult
probleme re-
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There remaineth yet one difficulty of moment to be determined : which is, why when through a glasse, two colours (namely, blew and red) are cast from a candle upon a paper or wall, if you put your eye in the place of one of the colours that shineth upon the wall, and so that colour commeth to shine upon your eye, in such sort that another man who looketh upon it, will see that colour plainly upon your eye, neverthelesse, you shall see the other colour in the glasse ? As for example, if on your eye there shineth a red, you shall see a blew in the glasse, and if a blew shineth upon your eye, you shall see a red.

The reason hereof is, that the colours which appearing the glasse, are of the nature of those luminous colours which we first explicated, that arise from looking upon white and black bordering together : for a candle standing in the ayr, is as it were a white situated between two blacks : the circumstant dusky Ayr, having the nature of a black : so then, that side of the candle which is seen through the thicker part of the glasse, appeareth red ; and that which is seen through the thinner, appeareth blew : in the same manner as when we look through the glasse ; whereas the colours shine contrarywise upon a paper or reflecting object, as we have already declared, together with the reasons of both these appearances ; each fitted to its proper case, of looking through the glasse upon the luminous object surrounded with darknesse, in the one ; and of observing the effect wrought by the same luminous object in some medium or upon some reflectent superficies, in the other.

And to confirm this, if a white paper be set standing hollow before the glass: (like half a hollow pillar, whose flat standeth edgewise towards the glasse, so as both the edges may be seen through it) the further edge will seem blew, and the neerer will be red, and the like will happen, if the paper be held in the free ayr parallel to the lower superficies of the glasse, without any black carpet to limit both ends of it (which serveth to make the colours the clearer) so that in both cases, the ayr serveth manifestly

telly for a black ; in the first, between the two white edges ; and in the second, limiting the two white ends ; and by consequence, the ayr about the candle must likewise serve for two blacks, including the light candle between them.

Several other delightfull experiments of luminous colours I might produce, to confirm the grounds I have layd, for the nature and making of them. But I conceived that these I have mentioned, are abundantly enough for the end I propose unto my self : therefore I will take my leave of this supple and nice subject ; referring my Reader (if he be curious to entertain himself with a full variety of such shining wonders) to our ingenious Countrey-man, and my worthy friend, Mr. Hall : who at my last being at Liege, shewed me there most of the experiences I have mentioned, together with severall other very fine and remarkable curiosities concerning light ; which he promised me he would shortly publish in a work, that he had already cast and almost finished upon that subject : and in it, I doubt not but he will give entire satisfaction to all the doubts and Problemes that may concur in this subject : whereas my little exercise formerly in making experiments of this kind, and my lesse conveniency of attempting any now, maketh me content my self with thus spinning of a coarse thred from wooll carded me by others, that may run through the whole doctrine of colours, whose causes have hitherto been so much admired : & that it will do so, I am strongly perswaded, both because if I look upon the causes which I have assigned *à priori*, me thinkes they appear very agreeable to nature and to reason ; and if I apply them to the severall Phænomens which Mr. Hall shewed me, and to as many others, as I have otherwise met with, I finde they agree exactly with them, and render a full account of them.

And thus you have the whole nature of luminous colours resolved into the mixtion of light and darknes : by the due ordering of which, who have skill therein, may produce any middle colour he pleaseth, as I my selfe have seen the experince of infinite changes in such sort made ; so that it seemeth unto me, nothing can be more manifest, than that luminous colours are generated in the way that is here delivered. Of which how that gentle, and obedient Philosophy of *Qualities* (readily obedient to what hard task soever you assign it) will render a rationall account ;

account; and what discreet vertue, it will give the same things to produce different colours, and to make different appearances, meerely by such nice changes of situation, I do not well understand: but peradventure the Patrons of it, may say that every such circumstance is a *Conditio sine qua non*: and therewith (no doubt) their Auditors will be much the wiser in comprehending the particular nature of light, and of the colours that have their origine from it.

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Of the Rain-
bow, and how
by the colour
of any body
we may know
the composition
of the body
it selfe

The Rainbow, for whose sake most men handle this matter of luminous colours, is generated in the first of the two wayes we have delivered or the production of such colours: and hath its origine from refraction, when the eye being at a convenient distance from the refracting body, looketh upon it to discern what appeareth in it. The speculation of which, may be found in that excellent discourse of *Monsieur des Cartes*, which is the sixt of his *Meteors*; where he hath with great accuratenesse delivered a most ingenious doctrine of this mystery: had not his bad chance of missing in former principles (as I conceive) somewhat obscured it. For he there giveth the cause so near, and so justly calculated to the appearances, as no man can doubt but that he hath found out the true reason of this wonder of nature, which hath perplexed so many great wits: as may almost be seen with our very eyes; when looking upon the fresh dew in a Sunshiny morning, we may in due positions perceive the rainbow colours, not three yards distant from us: in which we may distinguish even single drops with their effects. But he having determined the nature of light to consist in motion, and proceeding consequently, he concludeth colours to be but certain kinds of motion; by which I fear it is impossible that any good account should be given of the experiences we see.

But what we have already said in that point, I conceive is sufficient to give the Reader satisfaction therein: and to secure him, that the generation of the colours in the Rainbow, as well as all other colours, is likewise reduced to the mingling of light and darknesse: which is our principall intent to prove: adding thereunto by way of advertisement, for others whose leisure may permit them to make use thereof, that who shall ballance the proportions of luminous colours may peradventure make himselfe a step to judge of the natures of those bodies, which really

really and constantly do wear like dyes; for, the figures of the least parts of such bodies, joyntly with the connexion or mingling of them with pores, must of necessity be that which maketh them reflect light unto our eyes, in such proportions, as the luminous colours of their tincture and semblance do.

For two things are to be considered in bodies, in order to reflecting of light: either the extancies or the cavities of them; or their hardnesse and softnesse. As for the first; the proportions of light mingled with darknesse will be varied, according as the extancies or the cavities do exceed, and as each of them is great or small: since cavities have the nature of darknesse, in respect of extancies, as our modern Astronomers do shew, when they give account of the face (as some call it) in the orb of the Moon. Likewise in regard of soft or of resistant parts, light will be reflected by them, more or lesse strongly, that is, more or lesse mingled with darknesse; for whereas it reboundeth smartly back if it striketh upon a hard and resistant body, and accordingly will shew it self in a bright colour: it must of necessity not reflect at all, or very feebly, if it penetrateth into a bodie of much humidity, or if it loseth it self in the pores of it; and that little which commeth so weakly from it, must consequently appear of a dusky die: and these two being all the causes of the great variety of colours we see in bodies according to the quality of the body, in which the real colour appeareth, it may easily be determined from which of them it proceedeth: and then by the colour, you may judge of the composition and mixture of the rare and dense parts, which by reflecting light begetteth it.

In fine, out of all we have hitherto said in this Chapter, we may conclude the primary intent of our so long discourse, which is, that as well the senses of living creatures, as the sensible qualities in bodies are made by the mixtion of rarity and density, as well as the natural qualities we spoke of in their place: for it cannot be denied but that heat and cold, and the other couples or paires, which beat upon our touch, are the very same as we see in other bodies: the qualities which move our taste and smell, are manifestly a kin and joynd with them: light we have concluded to be fire: and of motion (which affecteth our eare) it is not disputable: so that it is evident, how all sensible qualities, ⁴ That all the sensible qualities are really bodies resulting out of several mixtures of rarity and density.

qualities, are as truly bodies, as those other qualities which we call naturall.

To this we may adde, that the properties of these sensible qualities are such as proceed evidently from rarity and density: for (to omit those which our touch taketh notice of, as too plain to be questioned) Physicians judge and determine the naturall qualities of meats, and of medicines, and of simples by their tastes and smells: by those qualities they finde out powers in them to do materiall operations; and such as our instruments for cutting, filing, brushing, and the like, do unto ruder and grosser bodies. All which vertues, being in these instruments by the different tempers of rarity and density, is a convincing argument, that it must be the same causes, which must produce effects of the same kind in their smells and tastes: and as for light, it is known how corporeally it worketh upon our eyes.

Again, if we look particularly into the composition of the organs of our senses, we shall meet with nothing but such qualities as we finde in the composition of all other naturall bodies. If we search into our eye, we shall discover in it nothing but diaphaneity, softnesse, divers colours, and consistencies; which all Anatomists, to explicate, do parallell in other bodies: the like is of our tongue, our nosethrills, and our eares. As for our touch, that is so material a sense, and so diffused over the whole body, we can have no difficulty about it. Seeing then that all the qualities we can discover in the organs of our senses are made by the various minglings of rarity with density, how can we doubt, but that the active powers over these patients, must be of the same nature and kind?

Again, seeing that examples above brought, do convince, that the objects of one sense, may be known by another; who can doubt of a community among them, if not of degree, at the least of the whole kind? As we see that the touch is the groundwork of all the rest; and consequently, that being evidently corporeal and consisting in a temper of rarity and density, why should we make difficulty in allowing the like of the rest?

Besides, let us compose of rarity and density, such tempers as we finde in our senses; and let us again compose of rarity and density, such actors, as we have determined the qualities, which we call sensible, to be; and will it not manifestly follow, that these

these two applyed to one another, must produce such effects, as we affirm our senses have? that is, to passe the outward objects, by different degrees, unto an inward receiver.

Againe, let us cast our eyes upon the naturall resolution of bodies, and how they move us, and we shall thereby discover, ^{s.} why the senses are enely both what the senses are, and why they are just so many, and five in number: with a conclusion of all the former doctrine concerning them. For an outward body may move us, either in its own bulk or quantity; or as it worketh upon another. The first is done by the touch, the second by the ear, when a body moving the ayr, maketh us take notice of his motion. Now in resolution, there are three active parts proceeding from a body, which have power to move us. The fiery part, which you see, worketh upon our eyes by the vertue of light. The ayrie part, which we know moveth our nolethrills, by being sucked in with the ayr. And lastly the salt, which dissolveth in water, and so moveth our watry sense; which is our tast.

And these being all the active parts, that shew themselves in the resolution of a body; how can we imagine there should be any more senses to be wrought upon? for what the stable body sheweth of it self, will be reduced to the touch: what, as it moveth, to hearing: what the resolutions of it, according to the natures of the resolved atomes that fly abroad, will concern the other three senses, as we have declared. And more wayes of working, or of active parts, we cannot conceive to spring out of the nature of a body.

Finally, if we cast our eyes upon the intention of nature: to what purpose are our senses, but to bring us into knowledge of the natures of the substances we converse withall? surely, to effect this, there cannot be invented a better, or more reasonable expedient, than to bring unto our judgement-feat the likenesses or extracts of those substances, in so delicate a modell, that they may not be offensive or cumbersome; like so many patterns presented unto us, to know by them, what the whole piece is: for all similitude is a communication between two things in that quality, wherein their likenesse consisteth: and therefore we cannot doubt, but that nature hath given us by the means we have explicated, an essay to all the things in the world, that fall under our commerce, whereby to judge whether they be profitable or notive unto us; and yet in so delicate and

subtile a quantity, as may in no waies be offensive to us, whiles we take our measures to attract what is good, and avoyd what is noxious.

THE TWO AND THIRTIETH CHAPTER.

Of sensation, or the motion whereby sense is properly exercised.

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Mounſieur des
Cartes his o-
pinion touch-
ing ſenſation.

OU T of the conſiderations which we have delivered in theſe laſt Chapters, the Reader may gather the unreaſonableneſſe of vulgar Phyloſophers, who to explicate life and ſenſe, are not content to give us termes without explicating them; but will force us to believe contradictions: telling us, that life conſiſted in this, that the ſame thing hath a power to work upon it ſelf: and that ſenſation, is a working of the active part of the ſame ſenſe, upon its paſſive part; and yet will admit no parts in it: but will have the ſame indiviſible power to work upon it ſelf. And this, with ſuch violence and down-bearing of all oppoſition, that they deem him not conſiderable in the ſchools, who ſhall offer onely to doubt, of what they teach him hereabout; but brand him with the cenſure of one who knoweth not, and contradicte the very firſt principles of Phyloſophy. And therefore, it is requiſite that we ſhould look ſomewhat more particularly into the manner how ſenſation is made.

Mounſieur des Cartes (who by his great and heroike attempts, and by ſhewing mankind how to ſteer and husband their reaſon to beſt advantage, hath left us no excuſe for being ignorant of any thing worth the knowing) explicating the nature of ſenſe, is of opinion, that the bodies without us, in certain circumſtances, do give a blow upon our exterior organs: from whence, by the continuity of the parts, that blow or motion is continued, till it come to our brain and ſeat of knowledge; upon which it giveth a ſtroke answerable to that, which the outward ſenſe firſt received: and there this knock cauſing a particular effect, according to the particular nature of the motion (which dependeth of the nature of the object that produceth it) our ſoul and mind hath notice by this means, of every thing

thing that knocketh at our gates : and by the great variety of knocks or motions that our brain feeleth (which riseth from as great a variety of natures in the objects that cause them) we are enabled to judge of the nature and conditions of every thing we converse withall.

As for example : he conceiveth light to be nothing else but a percussio made by the illuminant upon the ayr, or upon the ethereall substance, which he putteth to be mixed with, and to runne through all bodies : which being a continue medium between the illuminant and our sense; the percussio upon that, striketh also our sense; which he calleth the nerve that reacheth from the place strucken (to wit, from the bottome of our eye) unto the brain. Now, by reason of the continuity of this string or nerve, he conceiveth that the blow which is made upon the outward end of it by the ether, is conveyed by the other end of it to the brain; that end, striking the brain in the same measure as the ether struck the other end of it : like the jack of a Virginal, which striketh the sounding cord, according as the Musicians hand presseth upon the stop. The part of the brain which is thus strucken, he supposeth to be the fantasie, where he deemeth the soul doth reside ; and thereby taketh notice of the motion and object that are without. And what is said thus of sight, is to be applied proportionably to the rest of the senses.

This than is the summe of Monsieur des Cartes his opinion, which he hath very finely expressed, with all the advantages that opposite examples, significant words, and clear method can give unto a witty discourse. Which yet is but a part of the commendations he deserveth, for what he hath done on this particular. He is over and above all this, the first that I have ever met with, who had published any conceptions of this nature, whereby to make the operations of sense intelligible. Certainly, this praise will ever belong unto him, that he hath given the first hint of speaking groundedly, and to the purpose upon this subject, and whatsoever shall carry it any further (as what important mystery was ever borne and perfected at once ?) must acknowledge to have derived his light from him.

For my part, I shall so far agree with him, as to allow mo-

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The Authors
opinion touch
ing sensation.

tion alone to be sufficient to work sensation in us: and not onely to allow it sufficient, but also to professe, that not onely this, but that no other effect whatsoever can be wrought in us, but motion, and by means of motion. Which is evident out of what we have already delivered, speaking of bodies in generall; that all action among them, either is locall motion, or else followeth it: and no lesse evident, out of what we have declared in particular, concerning the operations of the outward senses, and the objects that work upon them: and therefore, whosoever shall in this matter, require any thing further than a difference of motion, he must first seek other instruments in objects to cause it. For, examining from their very origine, the natures of all the bodies we converse withall; we cannot finde any ground to believe they have power or meanes to work any thing beyond motion.

But I shall crave leave to differ from him, in determining what is the subject of this motion, whereby the brain judgeth of the nature of the thing that causeth it. He will allow no local change of any thing in a man, further than certain vibrations of strings, which he giveth the objects to play upon from the very sense up to the brain: and by their different manners of shaking the brain, he will have it know, what kind of thing it is that striketh the outward sense, without removing any thing within our body from one place to another. But I shall go the more common way; and make the spirits to be the porters of all newes to the brain: onely adding thereunto, that these newes which they carry thither, are materiall participations of the bodies that work upon the outward organs of the senses; and passing through them, do mingle themselves with the spirits, and so do go whither they carry them, that is, to the brain; unto which from all parts of the body, they have immediate resort, and a perpetuall communication with it.

So that, to exercise sense (which our Latines do call *sentire*; but in English we have no one word common to our severall particular notions of divers perceptions by sense) is, *Our brain to receive an impression from the extern object by the operation or mediation of an organical part made for that purpose, and some one of those which we term an extern sense; from which impression, usually floweth some motion proper to the living creature*

ture. And thus you see that the outward senses, are not truly senses, as if the power of sensation were in them: but in another meaning, to wit, so farre as they are instruments of qualifying or conveying the object to the braine.

Now, that the spirits are the instruments of this conveyance, is evident, by what we daily see, that if a man be very attentive to some one extern object (as to the hearing or seeing of something that much delighteth or displeaseth him) he neither heareth or seeth any thing, but what his mind is bent upon; though all that while, his eyes and eares be open, and severall of their objects be present, which at other times would affect him. For what can be the reason of this, but that the brain employing the greatest part of his store of spirits about that one object, which so powerfully entertaineth him, the others find very few free for them to imbue with their tincture? And therefore, they have not strength enough to give the brain a sufficient tast of themselves, to make it be observed; nor to bring themselves into a place where they may be distinctly discerned: but striving to get unto it, they lose themselves in the throng of the others, who for that time do besiege the brain closely. Whereas, in Monsieur des Cartes his way (in which no spirits are required) the apprehension must of necessity be carried precisely according to the force of the motion of the extern object.

³
Reasons to
perswade the
authors opini-
on.

This argument I confesse, is not so convincing a one against his opinion, but that the necessity of the consequence may be avoided; and another reason be given for this effect, in Monsieur des Cartes his doctrine: for he may say, that the affection being vehemently bent upon some one object, may cause the motion to be so violent by the addition of inward percussions, that the other coming from the outward sense, being weaker, may be drowned by it; as lesser sounds are by greater, which do forcibly carry our eares their way, and do fill them so entirely, that the others cannot get in to be heard: or as the drawing of one man that pulleth backwards, is not felt when a hundred draw forwards. Yet this is hard to conceive, considering the great eminency which the present object hath over an absent one, to make it self be felt: whence it followeth, that the multiplication of motion must be extreamly encreased within, to overtop

and bear down the motion, cauled by a present object actually working without.

But that which indeed convinceth me to beleieve I go not wrong in this course, which I have set down for extern bodies working upon our sense and knowledge: is first, the convenience, and agreablenesse to nature, both in the objects and in us, that it should be done in that manner: and next, a difficulty in Mounſieur des Cartes his way, which me thinketh, maketh it impossible that his should be true. And then his being absolutely the best of any I have hitherto met withall, and mine supplying what his falleth short in, and being sufficient to perform the effects we see: I shall not think I do amisse in beleieving my own to be true, till some body else shew a better.

4
That vitall
spirits are the
immediate
instruments of
sensation by
conveying
sensible qua-
lities to the
brain.

Let us examin these considerations one after another. It is manifest by what we have already established, that there is a perpetuall flux of little parts or atomes out of all sensible bodies, that are composed of the four Elements, and are here in the sphere of continuall motion by action and passion: and such it is, that in all probability these little parts cannot chuse but get in at the doores of our bodies, and mingle themselves with the spirits that are in our nerves. Which if they do, it is unavoydable, but that of necessity they must make some motion in the brain; as by the explication we have made of our outward senses, is manifest: and the brain being the source and origin of all such motion in the animal, as is termed voluntary; this stroke of the object, will have the power to cause some variation in its motions that are of that nature: and by consequence, must be a sensation, for, that change which being made in the brain by the object, is caused of voluntary motion in the animal, is that, which we call sensation.

But we shall have best satisfaction, by considering how it fareth with every sense in particular. It is plain, that our touch or feeling is affected by the little bodies of heat, or cold, or the like, which are squeezed or evaporated from the object; and do get into our flesh, and consequently, do mingle themselves with our spirits: and accordingly, our hand is heated with the floud of subtile fire, which from a great one without, streameth into it: and is benumbed with multitudes of little bodies of cold, that settle in it. All which little bodies, of heat, or of cold

cold, or of what kind so ever they be, when they are once got in, must needs mingle themselves with the spirits they meet with in the nerve: and consequently, must go along with them up to the brain: for the channell of the nerve being so little, that the most accurat inspectours of natur cannot distinguish any little cavity or hole running along the substance of it: and the spirits which ebbe and flow in those channells, being so infinitely subtil and in so small a quantity, as such channells can contain: it is evident, that an atome of insensible bignesse, is sufficient to imbue the whole length and quantity of spirit that is in one nerve: and that atome, by reason of the subtilty of the liquor it is immersed in, is presently and as it were instantly, diffused through the whole substance of it: the source therefore of that liquor being in the brain, it cannot be doubted, but that the force of the extern object must needs affect the brain according to the quality of the said atome: that is, give a motion, or knock, conformable to its own nature.

As for our tast, it is as plain, that the little parts expressed out of the body which affecteth it, do mingle themselves with the liquor, that being in the tongue, is continue to the spirits: and then, by our former argument it is evident, they must reach unto the brain. And for our smelling, there is nothing can hinder odours from having immediate passage up to our brain, when by our nose, they are once gotten into our head.

In our hearing, there is a little more difficulty: for sound being nothing but a motion of the Ayr, which striketh our eare; it may seem more then needeth, to send any corporeall substance into the brain: and that it is sufficient, that the vibrations of the outward ayr, shaking the drum of the eare, do give a like motion to the ayr within the eare, that on the inside toucheth the tympane: and so this ayr thus moved shaketh and beateth upon the brain. But this I conceive, will not serve the turn; for if there were no more but an actual motion, in the making of hearing; I do not see how sounds could be conserved in the memory: since of necessity, motion must alwayes reside in some body; which argument, we shall presse anon against Mounseieur des Cartes his opinion for the rest of the senses.

How sound
is conveyed
to the brain
by vitall
spirits.

Out of this difficulty, the very inspection of the parts within

the ear, seemeth to lead us : for had there been nothing necessary besides motion, the very striking of the outward ayr against the tympanum, would have been sufficient without any other particular and extraordinary organization, to have produced sounds, and to have carried their motions up to the brain : as we see the head of a drum bringeth the motions of the earth unto our ear, when we lay it thereunto, as we have formerly delivered. But Anatomists finde other tools and instruments, that seem fit to work and forge bodies withall ; which we cannot imagine nature made in vain. There is a Hammer and an Anvile : whereof the Hammer, striking upon the Anvile, must of necessity beat off such little parts of the brainy streams, as flying about, do light and stick upon the top of the Anvile : these by the trembling of the Ayr, following its course, cannot misse of being carried up to that part of the brain, whereunto the Ayr within the ear is driven by the impulse of the sound : and as soon as they have given their knock, they rebound back again into the cells of the brain, fitted for harbours to such winged messengers : where they remain lodged with quietnesse, till they be called for again, to renew the effect which the sound did make at the first : and the various blows which the Hammer striketh, according to the various vibrations of the tympanum (unto which the hammer is fastened ; and therefore is governed by its motions) must needs make great difference of bignesses, and cause great variety of smartnesses of motion, in the little bodies which they forge.

6.
How colours
are conveyed
to the brain
by vitall spi-
rits.

The last sense is of seeing ; whose action we cannot doubt, is performed by the reflection of light unto our eye, from the bodies which we see : and this light commeth impregnated, with a tincture drawn from the superficies of the object it is reflected from ; that is, it bringeth along with it, severall of the little atoms, which of themselves do stream, and it cutteth from the body it struck upon, and reboundeth from ; and they mingling themselves with the light, do in company of it get into the eye : whose fabrick, is fit to gather and unite those species, as you may see by the anatomy of it : and from the eye, their journey is but a short one to the brain : in which, we cannot suspect that they should lose their force ; considering, how others that come from organes further off, do conserve theirs : and likewise considering
the

the nature of the optick spirits, which are conceived to be the most refined of all that are in mans body.

Now, that light is mingled with such little atomes issuing out of the bodies from which it is reflected; appeareth evidently enough, out of what we have Said, of the natures and operations of fire and light: and it seemeth to be confirmed, by what I have often observed in some chambers where people seldome come: which having their windows to the south, so as the sun lyeth upon them a great part of the day in his greatest strength, and their curtaines being continually drawne over them, the glasse becomes dyed very deep of the same colour the curtain is of: which can proceed from no other cause, but that the beams which shoot through the glasse, being reflected back from the curtain, do take something along with them from the superficies of it; which being of a more solid corpulence then they, is left behind (as it were in the strainer) when they come to presse themselves through passages and pores, too little for it to accompany them in: and so those atomes of colour, do sticke upon the glasse, which they cannot penetrate.

Another confirmation of it is, that in certain positions, the Sun reflecting from strong colours, will cast that very colour upon some other place; as I have often experienced in lively scarlet, and cloth of other smart colours: and this, not in that gloating wise, as it maketh colours of pure light, but like a true reall dye; and so, as the colour will appear the same to a man wheresoever he standeth.

Having thus shewed in all our senses, the conveniency and agreeablenesse of our opinion with nature; (which hath been deduced, out of the nature of the objects, the nature of our spirits, the nature and situation of our nerves, and lastly from the property of our brain:) our next consideration shall be, of the difficulty that occurreth in Mr. des Cartes his opinion. First we know not how to reconcile the repugnancys, appearing in his position of the motion of the ether; especially in light, for that Ethereal substance, being extream rare, must perforce be either extream liquid or extream brittle; if the first, it cannot chose but bow and be pressed into foulds, and bodies of unequal motions, swimming every where in it; and so it is impossible that it should bring unto the eye any constant apparition of the first mover.

But

7
Reasons against Moun-
sieur des
Cartes his
opinion.

But let us suppose there were no such generall interruptions, every where encountering, and disturbing the conveyance or the first simple motion : yet, how can we conceive that a push given so farre off, in so liquid an element, can continue its force so farre? We see that the greatest thunders and concussions, which at any time happen among us, cannot drive and impart their impulse the ten thousandth part of the vast distance, which the Sun is removed from our eye ; and can we imagin, that a little touch of that luminous body, should make an impression upon us, by moving another so extreemly liquid and subtile, as the Ether is supposed ; which like an immense Ocean, tossed with all varieties of motion, lieth between it and us ?

But admit there were no difficulty, nor repugnance in the medium, to convey unto us a stroke, made upon it by the Suns motion : let us at the least examin, what kind of motions we must allow in the Sun, to cause this effect. Certainly, it must needs be a motion towards us, or else it cannot strike and drive the medium forward, to make it strike upon us. And if it be so, either the Sun must perpetually be comming nearer and nearer to us ; or else it must ever and anon be receding backwards, as well as moving forwards. Both which, are too chymericall for so great a wit to conceit.

Now, if the Ether be brittle, it must needs reflect upon every thing it meeteth with in its way, and must be broken and shivered by every body that moveth a crosse it: and therefore must alwaies make an uncertain and most disorderly percussion upon the eye.

Then again ; after it is arrived to the sense, it is no waies likely it should be conveyed from thence to the brain, or that nature intended such a kind of instrument as a nerve, to continue a precise determinate motion : for if you consider how a lute string, or any other such medium conveyeth a motion made in it ; you will finde, that to do it well and clearly, it must be stretched throughout to its full extent, with a kind of stiffnessse : whereas our nerves are not straight, but lie crooked in our body ; and are very lither, til upon occasion spirits comming into them, do swell them out. besides, they are bound to flesh, and to other parts of the body ; which being cessible, must needs adul the stroak, and not permit it to be carried farre. And lastly,

lastly, the nerves are subject to be at every turn contracted and dilated, upon their own account, without any relation to the stroakes beating upon them from an extern agent: which is by no meanes, a convenient disposition for a body, that is to be the porter of any simple motion; which should alwayes lie watching in great quietnesse, to observe scrupulously, and exactly the errand he is to carry: so that for my part, I cannot conceive, nature Intended any such effect, by mediation of the sinews.

But Monsieur des Cartes endeavoureth to confirm his opinion, by what useth to fall out in palsies, when a man loseth the strength of moving his hands, or other members and nevertheless retaineth his feeling: which he imputeth to the remaining intire of the strings of the nerves, whiles the spirits are some way defective. To this we may answer, by producing examples of the contrary in some men, who have had the motion of their limbs intire and no wayes prejudiced, but have had no feeling at all, quite over their whole case of skin and flesh: as particularly a servant in the Colledge of Physicians in London, whom the learned Harvey (one of his Masters) hath told me, was exceeding strong to labour, and very able to carry any necessary burthen, and to remove things dextero sive, according to the occasion: and yet he was so void of feeling, that he used to grind his hands against the walls, and against course lumber, when he was imployed to rummage any; in so much, that they would runne with blood, through the grating of the skin, without his feeling of what occasioned it.

In our way, the reason of both these conditions of people, (the paralytick and the insensible) is easy to be rendred: for they proceed out of the divers disposition of the animal spirits in these parts: which if they thicken too much, and become very grosse, they are not capable of transmitting the subtile messengers of the outward world, unto the tribunall of the brain, to judge of them. On the other side, if they be too subtile, they neither have, nor give power to swell the skin, and so to draw the muscles to their heads. And surely Monsieur des Cartes taketh the wrong way, in the reason he giveth of the Palsie: for it proceedeth out of abundance of humours; which clogging the nerves, rendreth them washy, and maketh them lose their drynesse, and become lithier, and consequently, unfit and unable, in his

8
That the symptoms of the palse do no way confirm Monsieur des Cartes his opinion.

his opinion, for sensation (which requireth stiffenesse) as well as for motion.

9. *That Monsieur des Cartes his opinion, cannot give a good account, how things are conserved in the memory.* Yet besides all these, one difficulty more remaineth against this doctrine, more insuperable (if I mistake not) than any thing or all together, we have yet said: which is, how the memory should conserve any thing in it, and represent bodies to us, when our fantasie calleth for them, if nothing but motions do come into the brain. For it is impossible, that in so divisible a subject as the spirits, motion should be conserved any long time: as we see evidently in the ayr; through which move a flaming taper never so swiftly, and as soon as you set it down, almost in the very instant, the flame of it leaveth being driven or shaken on one side, and goeth quietly and evenly up its ordinary course: thereby shewing, that the motion of the ayr which for the time was violent, is all of a suddain quieted and at rest: for otherwise, the flame of the taper would blaze that way the Ayr were moved. Assuredly, the bodies that have power to conserve motion long, must be dry and hard ones. Nor yet can such conserve it very long, after the cause which made it, ceaseth from its operation. How then can we imagine, that such a multitude of pure motions, as the memory must be stored withall for the use and service of a man, can be kept on foot in his brain, without confusion; and for so long a time as his memory is able to extend unto? Consider a lesson plaide upon the Lute or Virginals; and think with your selfe, what power there is, or can be in nature, to conserve this lesson ever continually playing: and reflect, that if the impressions upon the common sense are nothing else but such things, then they must be actually conserved, alwaies actually moving in our head, to the end they be immediatly produced, whensoever it pleaseth our will to call them.

And if peradventure it should be replied, that it is not necessary the motions themselves should alwaies be conserved in actuall being; but that it is sufficient there be certain causes kept on foot in our heads, which are apt to reduce these motions into act, whensoever there is occasion of them: all I shall say hereunto is, that this is meerly a voluntary position, and that there appeareth no ground for these motions to make and constitute such causes; since we neither meet with any instruments,

ments, nor discover any signes, whereby we may be induced to believe or understand any such operation.

It may be urged, that divers sounds are by diseases oftentimes made in our eares, and appearances of colours in our fantasie. But first, these colours and sounds, are not artificiall ones, and disposed and ordered by choice and judgement; for no story hath mentioned, that by a disease any man ever heard twenty verses of Virgill, or an ode of Horace in his eares: or that ever any man saw fair pictures in his fanſy, by means of a blow given him upon his eye. And secondly, such colours and sounds as are objected, are nothing else, but (in the first case) the motion of humours in a mans eye by a blow upon it; which humours have the vertue of making light, in such sort as we see Sea-water hath when it is clashed together: and (in the second case) a cold vapour in certain parts of the brain, which causeth beatings or motion there; whence proceedeth the imitation of sounds: so that these examples do nothing advantage that party thence to infer, that the similitudes of objects may be made in the common sense, without any real bodies reserved for that end.

Yet I intend not to exclude motion from any commerce with the memory, no more than I have done from sensation. For I will not only grant, that all our remembering is performed by the meanes of motion; but I will also acknowledge, that (in men) it is, for the most part, of nothing else but of motion. For what are words but motion? And words are the chiefeſt objects of our remembrance. It is true, we can, if we will, remember things in their own shapes, as well as by the words that expresse them; but experience telleth us, that in our familiar conversation, and in the ordinary exercise of our memory, we remember and make use of the words, rather than of the things themselves.

Besides, the impressions which are made upon all our other senses, as well as upon our hearing, are likewise for the most part of things in motion: as if we have occasion to make a conception of a man, or of a horse, we ordinarily conceive him Walking, or Speaking, or Eating, or using some motion in time: and as these impressions are successively made upon the outward Organs; so are they successively carried into the fantasie, and
by

by like succession, are delivered over into the memory : from whence, when they are called back again into the fantasie, they move likewise successively ; so that in truth, all our memory will be of motion; or in the least, of bodies in motion: yet it is not chiefly of motion, but of the things that are moved ; unlesse it be, when we remember words: and how those motions, do frame bodies which move in the brain, we have already touched.

THE THREE AND THIRTIETH CHAP.

Of Memory.

How things
are conserved
in the memo-
ry.

BUt how are these things conserved in the brain ? And how do they revive in the fantasie, the same motions by which they came in thither at the first ? Monsieur des Cartes hath put us in hope of an explication: and were I so happy, as to have seen that work of his, which the World of learned men so much longeth for ; I assure my self, I should herein receive great help and furtherance by it. Although withall I must professe, I cannot understand how it is possible, that any determinate motion should long be preserved untainted in the brain ; where there must be such a multitude of other motions in the way, to mingle with it, and bring all into confusion. One day I hope this jewel will be exposed to publike view, both to do the Author right, and to instruct the World.

In the mean time, let us see what our own principles afford us. We have resolved, that sensation is not a pure driving of the animall spirits, or of some penetrable body in which they swim, against that part of the brain, where knowledge resideth : but that it is indeed the driving thither of solid materiall bodies (exceeding little ones) that come from the objects themselves. Which position, if it be true, it followeth, that these bodies must rebound from thence upon other parts of the brain ; where at the length they finde some vacant cell, in which they keep their ranks and files in great quiet and order ; all such sticking together, and keeping company with one another, that entered in together : and there they lye still and

and are at rest, untill they be stirred up, either by the naturall appetite, (which is the ordinary course of beasts) or by chance, or by the will of the man in whom they are, upon the occasions he meeteth with of searching into them. Any of these three causes raiseth them up, and giveth them the motion that is proper to them; which is the same with that, whereby they came in at the first: for (as *Galileus* teacheth us) every body hath a particular motion peculiarly proper to it, when nothing diverteth it; and then they slide successively, through the fantasie in the same manner, as when they presented themselves to it the first time. After which, if it require them no more; they return gently to their quiet habitation in some other part of the brain, from whence they were called and summoned by the fantasies messengers, the spirits: but if it have longer use of them, and would view them better, than once passing through permitteth; then they are turned back again, and lead anew over their course, as often as is requisite: like a Horse, that a Rider paceth sundry times along by him, that he sheweth him to; whiles he is attentive to mark every part and motion in him.

But let us examin a little more particularly, how the causes we have assigned, do raise these bodies that rest in the memory, and do bring them to the fantasie. The middlemost of them (namely chance) needeth no looking into, because the principles that govern it, are uncertain ones. But the first, and the last, (which are, the appetite, and the will) have a power (which we will explicate hereafter) of moving the brain and the nerves depending of it, conveniently and agreeably to their disposition. Out of which it followeth, that the little similitudes which are in the caves of the brain wheeling and swimming about (almost in such sort, as you see in the washing of Currants or of Rice, by the winding about and circular turning of the Cooks hand) divers sorts of bodies do go their courses for a pretty while; so that the most ordinary objects cannot choose but present themselves quickly, because there are many of them, and are every where scattered about: but others that are fewer, are longer ere they come in view: much like as in a pair of beads, that containing more little ones than great ones, if you pluck to you the string, they all hang upon

2.

How things conserved in the memory are brought back into the fantasies.

upon, you shall meet with many more of one sort, than of the other.

Now, as soon as the brain hath lighted on any of those it seeketh for, it putteth as it were a stop upon the motion of that; or at the least, it moveth it so, that it goeth not far away, and is revocable at will: and seemeth like a bait to draw into the fantasie, others belonging unto the same thing, either through similitude of nature, or by their connexion in the impression: and by this means hindereth other objects, not pertinent to the work the fantasie hath in hand, from offering themselves unseasonably in the multitudes that otherwise they would do. But if the fantasie should have mistaken one object for an other, by reason of some resemblance they have between themselves; then it shaketh again the liquid medium they all float in, and rooſeth every species lurking in remotest corners, and runneth over the whole bead-roule of them: and continneth this inquisition and motion, till either it be satisfied with retrieving at length what it required, or that it be grown weary with tossing about the multitude of little inhabitants in its numerous empire, and so giveth over the search, unwillingly and displeasedly.

3.
A confirmation
of the former
doctrine.

Now, that these things be as we have declared, will appear out of the following considerations, First, we see that things of quite different natures, if they come in together, are remembered together: upon which principle the whole art of memory dependeth: such things cannot any way be comprised under certain heads, nor be linked together by order and consequence, or by any resemblance to one another: and therefore all their connexion must be, that as they came in together into the fantasie, so they remain together in the same place in the memory: and their first coupling must proceed from the action that bound them together, in driving them in together.

Next, we may observe, that when a man seeketh and tumbleth in his memory for any thing he would retrieve, he hath first some common and confused notion of it: and sometimes he hath a kind of flasing or fading likenesse of it: much what as when in striving to remember a name, men use to say, it is at their tongues end: and this sheweth, that he attracteth those things he desireth, and hath use of, by the likenesse of something

thing belonging to them. In like manner, when hunger maketh one think of meat, or thirst maketh one dream of drink, or in other such occasions, wherein the naturall appetite stirreth objects in the memory and bringeth them to the fantasie; it is manifest, that the spirits informing the brain of the defect and pain, which severall parts of the body do endure, for want of their due nourishment; it giveth a motion to the heart, which sendeth other spirits up to supply the brain, for what service it will order them: by which, the brain being fortified, it followeth the pursuite of what the living creature is in want of; untill the distempered parts be reduced into their due state, by a more solid enjoying of it.

Now, why objects that are drawn out of the memory, do use to appeare in the fantasie, with all the same circumstances which accompanied them at the time when the sense did send them thither (as when in the remembrance of a friend we consider him in some place, and at a certain time, and doing some determinate action) the reason is, that the same body, being in the same medium, must necessarily have the same kind of motion; and so consequently, must make the same impression upon the same subject. The medium which these bodies move in, (that is the memory) is a liquid vaporous substance, in which they float and swim at liberty.

Now, in such a kind of medium, all the bodies that are of one nature, will easily gather together, if nothing disturb them: for as when a tuned Lute string is stricken, that string by communicating a determinate species of vibration to the Ayre round about it, shaketh other strings, within the compasse of the moved ayre: not all, of what extent soever, but onely such, as by their naturall motion, would cause like curlings, and foulds in the Ayre, as the other doth; according to what Galileus hath at large declared: even so, when some atome in the brain is moved, all the rest there about, which are apt to be waisted with alike undulation, must needs be moved in chief: and so they moving, whiles the others of different motions that having nothing to rayse them, do either ly quiet, or move very little in respect of the former; it is no wonder if they assemble together, (and by the proper course of the brain) do meet at the common rendezvous of the fantasie.

D d

And

4
How things renewed in the fantasie, returne with the same circumstances that they had at first.

5.
How the me-
mory of things
past is lost, or
confounded :
and how it is
repaired 2.
gaine.

And therefore the more impressions, that are made from the same object upon the sense, the more participations of it will be gathered together in the memory : and the stronger impressions, it will upon occasion make in the fantasie : and themselves will be the stronger to resist any cause that shall strive to deface them. For we see, that multitude of objects overwhelmeth the memory ; and putteth out, or at the least, maketh unprofitable, those that are seldome thought on. The reason of which is, that they being little in quantity, because there are but few species of them ; they can never strike the seat of knowledge, but in company of others ; which being more and greater, do make the impression follow their nature against the lesser : and in tract of time, things seldome thought of, do grow to have but a maimed and confused shape in the memory ; and at length are quite forgotten. Which happeneth, because in the liquid medium, they are apt to moulder away, if they be not often repaired : which mouldering and defacing, is helped on by the shokes they receive from other bodies : like as in a magazin, a thing that were not regarded, but were carelessly tumbled up and downe, to make roome for others, and all things were promiscuously throwne upon it ; it would soone be bruised and crushed into a mishapen forme, and in the end be broken all in pieces.

Now, the repairing of any thing in the memory, is done by receiving new impressions from the object ; or in its absence, by thinking strongly of it : which is an assembling, & due peeing together of the severall particles of bodies, appertaining to the same matter. But sometimes it happeneth, that when the right one cannot be found intire, nor all the orderly pieces of it, be retrieved with their just correspondence to one another ; the fantasie maketh up a new one in the place of it : which afterwards, upon the presence of the object, appeareth to have been mistaken : and yet the memory, till then, keepeth quietly and unquestionedly for the true object, what either, the thought, or chance, mingling severall parts, had patched up together.

And from hence, we may discern, how, the loosing or confounding of ones memory, may happen either by sicknesse, that distemper the spirits in the brain, & disorder their motions, or by
some

some blowes on the head, whereby a man is astonied, and all things seem to turn round with him. Of all which effects, the causes are easy to be found in these suppositions we have layed.

THE FOURE AND THIRTIETH CHAP.

Of voluntary motion, Naturall faculties, and passions.

Hitherto we have laboured to convey the object into the brain: but when it is there, let us see what further effects it causeth: and how that action, which we call *voluntary motion*, doth proceed from the brain. For the discovery whereof, we are to note, that the brain is a substance composed of watry parts mingled with earthy ones: which kind of substances we see are usually full of strings: and so in strong hard beer, and in vinegar, and in other liquors of the like nature, we see (if they be exposed to the Sun) little long flakes, which make an appearance of Wormes or Maggats floating about. The reason whereof is, that some dry parts of such liquors, are of themselves as it were hairy or fleasy, that is have little downy parts, such as you see upon the legs of Flies, or upon Caterpillars, or in little locks of wooll; by which they easily catch and stick to the other litle parts of the like nature, that come near unto them: and if the liquor be moved, (as it is in the boyling of beer, or making of vinegar by the heat of the Sun) they become long strings; because the liquor breaketh the ties which are crosse to its motion: but such as lie along the stream, or rather the bubling up, do maintaine themselves in unity, and peradventure grow stronger, by the winding or foulding of the end of one part with an other: and in their tumbling and rouling still in the same course, the downy haire is crushed in, and the body groweth long and round, as happeneth to a lump of dough or wax, or wool, rouled a while in one uniform course. And so, comming to our purpose, we see that the brain and all that is made of it, is stringy; witnesse, the membranes, the flesh, the bones, &c. But of all the rest, those which be called fibers are more stringy: and the nerves seem to be but an

^I Of what
matter the
brain is com-
posed.

assembly of them : for although the nerves be but a great multitude of strings lying in a cluster; nevertheless, by the consent of Physicians and Anatomists, they are held to be of the very substance of the brain, dried to a firmer consistence then it is in the head.

This heap of strings (as we may call it) is enclosed in an outside made of membranes; whose frame, we need not here display: only we may note, that it is very apt and fit to stretch; and after stretching, to return again to its own just length. Next, we are to consider, how the brain is of a nature apt to swell and to sink again : even so much, that Fallopius reporteth, it doth swell according to the encrease of the moon : which whether it be true or no ; there can be no doubt, but that it bring of a substance which is full of skinnies and strings, is capable of being stretched, and of swelling upon light occasions; and of falling or sinking again upon as light: as being easily penetrable by vapours and by liquors, whose nature it is, to swell and to extend that which they enter into. Out of which it followeth, that it must be the nature of the nerves to do the like : and indeed, so much the more, by how much more dry they are then the brain : for we see that (to a certain measure) dryer things are more capable of extention by the ingression of wet, then moist things are; because these are not capable of receiving much more wet into them.

²
What is voluntary motion. These things being premised; let us imagine that the brain being first swelled, it doth afterwards contract it self; and it must of necessity follow, that seeing the nerves are all open towards the brain (though their concavities cannot be discerned) the spirits and moisture which are in the brain, must needs be pressed into the nerves : which being already stored with spirits, sufficiently to the proportion of their hard skinnies; this addition wil make them swell and grow hard, as a balloone doth, which being competently full of ayr, hath nevertheless more ayr pressed into it.

Since therefore; the masters of Anatomy do teach us, that in every muscle there is a nerve, which is spread into a number of little branches along that muscle; it must follow, that if these little branches be swollen, the flesh likewise of that muscle must also needs be swollen. Now the muscle having both its endes fastened,

fastned, the one in a greater bone, the other in a lesser ; and there being least resistance on that part, where the bone is lesser, and more moveable ; the swelling of the muscle cannot choose, but draw the little bone towards the great one, and by consequence, move that little bone : and this is that, which Philosophers usually call *Voluntary motion* : for since our knowledge remaineth in the braine, whatsoever is done by knowledge, must be done by the brain ; and most of what the brain worketh for the common service of the living creature, proceedeth also from knowledge ; that is from the motion of the fantastic, which we have expressed.

This matter being thus far declared, we may now enter upon the explication of certaine effects ; which peradventure might have challenged roome, in the precedent Chapter ; but indeed, could not well be handled without first supposing this last discourse : and it is, what is meant by those powers, that are called natural faculties : the which howsoever in their particulars they be manifold in a living creature, yet whensoever any of them is resolved, it appeareth to be compounded of some of these five ; to wit the attractive, the retentive, the secretive, the concoctive, and the expulsive faculty.

3.
What those powers are which are called naturall faculties.

Of which the attractive, the secretive, and the concoctive do not seeme to belong unto the nerves, for although we may conceive, that the part of the animall doth turne it selfe towards the thing which it attracteth ; neverthelesse, that very turning seemeth not to be done by vertue of the muscles, and of the nerves, but rather in a naturall way, as the motion of the heart is performed, in such sort as we have formerly declared : as for example, if the stomack when it is greedy of meat, draweth it self up towards the throat, it seemeth rather to be a kind of drynesse and of warping, such as we see in bladders or in leather, either by fire or by cold, which make them shrivel up and grow hard ; then that it is a true faculty of the living creature to seek after meat.

Nor need we extend our discourse any further about these three faculties ; seeing that we have already declared in common, how attraction, drying and mixture of active bodies with passive ones, is performed ; which needeth but applying unto these particulars, to explicate fully their natures : as for example ;

4.
How the attractive and secretive faculties work.

if the Kidneyes draw the matter of Urine unto them out of the Veines, it may be by any of the following three manners, to wit, either by draught, wet, or by steame. For if the serous parts that are in the blood which runneth in the Veines, do touch some dry parts conformable to their nature, tending towards the Kidneyes; they will infallibly adhere more to those dry parts, then to the rest of the blood. Which if they do in so great a quantity, that they reach to other further parts more dry then these, they will leave the first parts to go to the second: and thus by little, and little, will draw a line of Urine from the blood, if the blood do abound with it: and the neerer it commeth to the Kidneyes, the stronger still the attraction will be.

The like will happen, if the serosity which is in the blood, do touch some part wetted with a like serosity, or where such hath lately passed; for as we see that water will run more easily upon a wet part of a board or a stone, then upon a dry one; so you cannot doubt, but that if the serous part, which is mixed with the blood, do light upon a current of its own nature, it will stick more to that, then to the current of the blood; and so part from the blood, to goe that way which the current of its own nature goeth.

Besides, it cannot be doubted, but that from the Kidneyes, and from the passages between the Kidneys, and the Veines, in which the blood is conveyed, there ariseth a steame: whose nature is, to incorporate it selfe with serous matter, out of whose body it hath been extracted. This steame therefore, flying still to the serous blood which passeth by, must of necessity precipitate (as I may say) the serous parts of that blood; or rather must filter them out of their maine stock; and so will make them run in that current, from which it selfe doth flow. And thus you see how *Attraction* and *Secretion* are made: for the drawing of the serosity; without drawing the blood, is the parting of the Urine from the blood. And this example, of the Kidneyes operation, may be applyed to the attractions of all the other parts.

5. Now the concoctive faculty (which is the last or the three we
Concerning took together) consisteth of two parts: the one is, as it were a
the concoctive drying of the humour, which is to be concocted, the other is,
faculty. a ming-

a mingling the substance of the vessell in which the humour is concocted, with the humor it self: for as if you boyle divers kinds of liquors in brasse pannes, the pannes will taynt the liquor with the quality of the brasse; and therefore Physitians forbid the use of such, in the boyling of severall medicines: so much more in a living creatures body, there can be no doubt, but that the vessell in which any humour is concocted, doth give a tincture thereunto. Now concoction consisting in these two, it is evident, what the concoctive vertue is; to wit, heat, and the specificall property of the vessell which by heat is mingled with the humour.

There remaine yet, the retentive and the expulsive faculties: to be discoursed of; whereof one kind, is manifestly belonging to the voluntary motion which we have declared: namely that retention, and that expulsion, which we ordinarily make of the grosse excrements either of meat, or of drink, or of other humours, either from our head, or from our stomach, or from our Lungs; for it is manifestly done, partly by taking in of wind, and partly by comperling of some parts and opening of others: as Galen sheweth in his curious book *de usu partium*.

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Concerning
the retentive
and expulsive
faculties.

Another kind of retention and expulsion: in which we have no sense when it is made, (or if we have, it is of a thing done in us without our will, though peradventure we may voluntarily advance it) is made by the swelling of fibers in certain parts, through the confluence of humours to them, (as in our stomach it happeneth, by the drink and the juice of the meat that is in it) which swelling, closeth up the passages by which the contained substance should go out (as the moystening of the strings, and mouth of a purse, almost shutteth it) untill in some (for example, the stomach, after a meale) the humour being attenuated by little and little, getteth out subtilely; and so leaving lesse weight in the stomach, the bag which weigheth down lower, then the neather Orifice at which the digested meat issueth, riseth a little: and this rising of it is also furthered by the wrinkling up and shortning of the upper part of the stomach; which still returneth into its naturall corrugation, as the masse of liquid meat leaveth soaking it) which it doth by degrees, still as more and more goeth out; and so what remaineth filleth lesse place,

and reacheth not so high of the stomach : and thus at length, the residue and thicker substance of the meat, after the thinnest is got out in steame, and the middling part is boyled over in liquor, commeth to presse and gravitate wholly upon the orifice of the stomach ; which being then helped by the figure and lying of the rest of the stomach, and its strings and mouth relaxing, by having the juice which swelled them, squeezed out of them ; it openeth it self, and giveth way unto that which lay so heavy upon it, to tumble out. In others (for example, in a woman with child) the enclosed substance, (retained first by such a course of nature as we have set down) breaketh it self a passage by force, and openeth the orifice at which it is to go out by violence, when all circumstances are ripe, according to natures institution.

7
Concerning
expulsion
made by Physick.

But yet there is the expulsion which is made by physick, that requireth a little declaration. It is of five kinds : vomiting, purging by stooles, by urine, sweating, and salivation. Every one of which, seemeth to consist of two parts, namely, the disposition of the thing to be purged, and the motion of the nerves or fibers for the expulsion : as for example, when the Physitian giveth a purge, it worketh two things : the one is, to make some certain humour more liquid and purgeable then the rest ; the other is, to make the stomach or belly, suck or vent this humour. For the first, the property of the purge must be to precipitate that humour out of the rest of the blood ; or if it be thick, to dissolve it that it may runne easily. For the second, it ordinarily heateth the stomach ; and by that meanes it causeth the stomach to suck out of the veines, and so to draw from all parts of the body. Besides this, it ordinarily filleth the belly with wind, which occasioneth those gripings men feel when they take physick ; and is cause of the guts discharging those humours, which otherwise they would retain.

The like of this happened in salivation ; for the humours are by the same means brought to the stomach, and thence sublimed up to be spitten out : as we see in those, who taking Mercury into their body, either in substance or in smoke, or by application, do vent cold humours from any part ; the Mercury rising from all the body up to the mouth of the patient, as to the helm
of.

of a sublimatory : and the like some say of Tobacco.

As for vomiting, it is in a manner wholly the operation of the fibers, provoked by the feeling of some inconvenient body, which maketh the stomack wrinkle it self, and work and strive to cast out what offendeth it.

Sweating seemeth to be caused, by the heating of some intous body by the stomack; which being of subtile parts, is by heat dispersed from the middle to the circumference; and carrieth with it light humours, which turn into water as they come out into the ayr. And thus you see in generall, and as much as concerneth us to declare, what the natural faculties are: and this according to Galen his own mind: who affirmeth, that these faculties do follow the complexion, or the temper of the parts of a mans body.

Having explicated how voluntary motion proceedeth from the brain: our next consideration ought to be, to examine what it is, that such an object, as we brought, by meanes of the senses, into the brain from without, doth contribute to make the brain apply it self to work such voluntary motion. To which purpose, we will go a step or two back, to meet the object at its entrance into the sense; and from thence accompany it in all its journey and motions onwards. The object which striketh at the senses dore, and getting in, mingleth it self with the spirits it findeth there; is either conform and agreeable to the nature and temper of those spirits, or it is not: that is to say, in short, it is either pleasing or displeasing to the living creature: or it may be of a third kind, which being neither of these, we may terme indifferent. In which sort soever the object affect the sense, the spirits carry it immediately to the brain, unlesse some distemper or strong thought, or other accident hinder them.

Now, if the object be of the third kind; that is, be indifferent; as soon as it hath stricken the braine, it reboundeth to the circle of the memory: and there, being speedily joyued to others of its own nature, it findeth them annexed to some pleasing or displeasing thing, or it doth not: if not, in beasts it serveth to little use: and in men, it remaineth there untill it be called for: but if, either in its own nature, it be pleasing or displeasing; or afterwards in the memory it became

8

How the brain
is moved to
work volun-
tary motion.

became joynd to some pleasing or annoying fellowship ; presently, the heart is sensible of it : for the heart being joynd to the brain by straight and large nerves, full of strong spirits which ascend from the heart ; it is impossible, but that it must have some communication with those motions, which passe in the brain : upon which the heart, or rather the spirits about it, is either dilated or compressed.

And these motions, may be either totally of one kind, or moderated, and allayed by the mixture of its contrary : if of the former sort ; one of them we call joy, the other grieve ; which do continue about the heart (and peradventure do oppresse it, if they bee in the utmost extremity) without sending any due proportion of spirits to the brain, untill they settle a little, and grow more moderate.

Now, when these motions are moderate, they immediately send up some abundance of spirits to the brain, which if they be in a convenient proportion, they are by the brain thrust into such nerves as are fit to receive them: and swelling them, they give motion to the muscles and tendons that are fastned to them : and they do move the whole body, or what part of it is under command of those nerves, that are thus filled and swelled with spirits by the brain.

If the object was conformable to the living creature, then the brain sendeth spirits into such nerves, as carry the body to it : but if otherwise, it causeth a motion of aversion or flight from it. To the cause of this latter, we give the name of *Feare* : and the other, that carrieth on to the pursuit of the object, we call *Hope*. *Anger*, or *Audacity*, is mixed of both these ; for it seeketh to avoid an evil by embracing and overcoming it : and proceedeth out of abundance of spirits.

Now, if the proportion of spirits sent from the heart, be too great for the brain, it hindereth or perverteth the due operation both in man and beast.

9
Why pleasing
objects do di-
late the spirits
& displeasing
ones contract
them.

All which it will not be amisse to open a little more particularly : and first, why painfull or displeasing objects, do contract the spirits, and gratefull ones, do contrary wise dilate them ? It is, because the good of the heart consisteth in life, that is in heat & moysture: and it is the nature of heat, to dilate it self in

in moyſture; whereas cold and dry things, doe contract the bodies they work upon: and ſuch are enemies to the nature of men and beaſts: and accordingly experience, as well as reaſon, teacheth us, that all objects, which be naturally good, are ſuch as be hot and moyſt in the due proportion to the creature that is affected and pleaſed with them.

Now, the living creature being compoſed of the ſame principles, as the world round about him is; and the heart being an abridgement of the whole ſenſible creature; and being moreover full of blood, and that very hot; it cometh to paſſe, that if any of theſe little extracts of the outward world, doe arrive to the hot blood about the heart, it worketh in this blood ſuch like an effect, as we ſee a drop of water falling into a glaſſe of wine, which is preſently diſperſed into a competent compaſſe of the wine: ſo that any little object muſt needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unleſſe it be ſo little a one, as no effect will follow of it; and then, it is of that kinde, which above we called indifferent. If the enſuing effect be connatural to the heart, there riſeth a motion of a certaine ſume about the heart; which motion we call *pleaſure*; and it never fayleth of accompanying all thoſe motions which are good, as *Joy*, *Love*, *Hope*, and the like: but if the motion be diſpleaſing; there is likewiſe a common ſenſe of a heavineſs about the heart, which we call *griefe*: and it is common to *ſorrow*, *feare*, *hate*, and the like.

Now it is manifeſt by experience, that theſe motions are all of them different ones, and doe ſtrike againſt divers of thoſe parts of our body which encompaſſe the heart: out of which ſtriking followeth, that the ſpirits ſent from the heart, doe affect the braine diverſly; and are by it, conveyed into divers nerves: and ſo doe ſet divers members in action. Whence followeth, that certaine members are generally moved upon the motion of ſuch a paſſion in the heart, eſpecially in beaſtes, who have a more determinate courſe of working, then man hath: and if ſometimes we ſee variety, even in beaſtes, upon knowledge of the circumſtances, we may eaſily gueſſe at the cauſes of that variety: the particularities

rities of all which motions, we remit to Physitians and to Anatomists : advertising onely, that the fume of pleasure, and the heaviness of griefe, doe plainly shew, that the first motions doe participate of dilatation, and the latter of compression.

10.
Concerning
the five senses
of what use &
end they are.

Thus you see, how by the senses, a living creature becommeth judge of what is good, and of what is bad for him : which operation, is performed more perfectly in beasts ; and especially in those, who live in the free ayre, remote from humane conversation (for their senses are fresh and untaynted, as nature made them) then in men. Yet without doubt nature hath been as favourable in this particular to men, as unto them : were it not, that with disorder and excessse, we corrupt and oppresse our senses : as appeareth evidently by the story we have recorded of John of Leige : as also by the ordinary practice of some Hermites in the deserts, who by their tast or smell, would presently be informed whether the herbes, and roots, and fruits they met withall, were good or hurtfull for them, though they never before had triall of them.

Of which excellency of the senses, there remaineth in us onely some dimme sparkes, in those qualities which we call sympathies and antipathies : whereof the reasons are plaine, out of our late discourse : and are nothing else, but a conformity or opposition of a living creature, by some individual property of it, unto some body without it : in such sort, as its conformity or opposition unto things by its specifical qualities, is termed naturall or against nature. But of this we shall discourse more at large hereafter.

Thus it appeareth, how the senses are seated in us, principally for the end of moving us to, or from objects, that are good for us, or hurtfull to us. But though our Reader be content to allow this intent of nature, in our three inferiour senses ; yet he may peradventure not be satisfied, how the two more noble ones (the hearing and the seeing) doe cause such motions to, or from objects, as are requisite to be in living creatures for the preservation of them ; for (may he say) how can a man, by onely seeing an object, or by hearing the sound of it, tell what qualities it is imbued withall ? Or what motion of liking or disliking, can be caused in his heart, by his meere receiving the visible

ble species of an object at his eyes, or by his eares hearing some noise it maketh? and if there be no such motion there, what should occasion him, to prosecute or avoyd that object? When he tasteth, or smelleth, or toucheth a thing, he findeth it sweet, or bitter, or stinking, or hot, or cold; and is therewith either pleased or displeased: but when he onely seeth or heareth it, what liking or disliking can he have of it, in order to the preservation of his nature?

The solution of this difficulty, may in part appear out of what we have already said. But for the most part, the objects of these two nobler senses do move us, by being joyned in the memory with some other thing that did either please or displease some of the other three senses. And from thence it is, that the motion of going to imbrace the object, or aversion from it, doth immediately proceed: as when a dog seeth a man that used to give him meat, the species of the man coming into his fantasie, calleth out of his memory the others which are of the same nature, and are former participations of that man, as well as this fresh one is: but these are joyned with specieses of meat, because at other times they did use to come in together: and therefore the meat being a good unto him, and causing him (in the manner we have said) to move towards it; it wil follow that the dog will presently move towards that man, and expresse a contentedness in being with him. And this is the ground of all assuefaction in beasts, and of making them capable of receiving any instructions.

THE FIVE AND THIRTIETH CHAPTER.

Of the materiall instruments of Knowledge and Passion; of the severall effects of Passion; of Pain and Pleasure; and how the vitall spirits are sent from the brain into the intended parts of the body, without mistaking their way.

TO conclude this great businesse, which concerneth all the mutations and motions, that are made by outward Agents in a living creature, it will not be amisse to take a short and generall survey of the materiall instruments, which concur

^I That *Septum Lucidum* is the seat of the fantasie.

concur to this effect. Whereof the braine being the principall, or at least, the first and next of the principals ; we may take notice that it containeth, towards the middle of its substance, four concavities, as some do count them: but in truth, these four, are but one great concavity, in which four, as it were, divers roomes, may be distinguished. The neather part of these concavities, is very unequal, having joyned unto it a kind of net, wrought by the entangling of certain little arteries, and of small emanations from a *Sinus*, which are interwoven together. Besides this, it is full of kernels, which do make it yet more uneven.

Now, two rooms of this great concavity, are divided by a little body, somewhat like a skin, (though more fryable) which of it self is clear; but there it is somewhat dimmed, by reason that hanging a little slack, it somewhat shriveleth together: and this, Anatomists do call *Septum lucidum*, or *speculum*; and is an indifferent body from all the rest that are in the brain. This transparent body hangeth as it were straightwards from the forehead towards the hinder part of the head: and divideth the hollow of the brain, as far as it reacheth, in to the right and the left ventricles.

This part seemeth to me, (after weighing all circumstances and considering all the conveniences, and fitnesses) to be that and onely that, in which the fanisie or common sense resideth: though Monsieur des Cartes hath rather chosen a kernell to place it in. The reasons of my assertions are; first, that it is in the midle of the brain, which is the most convenient situation to receive the messages from all our body, that do come by nerve, some from before, and some from behind. Secondly, that with its two sides, it seemeth to be conveniently opposed to all such of our senses, as are double; the one of them sending its little messengers or atomes, to give it advertisements on one side, the other on the other side; so that it is capable of receiving impression indifferently from both. Again, by the nature of the body, it seemeth more fit to receive all differences of motion, then any other body neer it. It is also most conformable to the nature of the eye; which being our principal outward sense must needs be in the next degree to that which is elevated a strain above our outward senses. Fifthly, it is of a single & peculiar nature, whereas the kernels are many, and all of them of the same

con-

condition: quality and appearance. Sixtly it is seated in the very hollow of the brain; which of necessity must be the place and receptacle where the species and similitudes of things doe reside, and where they are moved and tumbled up and down, when we think of many things: And lastly, the situation we put our head in, when we think earnestly of any thing, favoureth this opinion: for then we hang our head forwards, as it were forcing the specieses to setle towards our forehead; that from thence they may rebound, and work upon this diaphanous substance.

This then supposed, let us consider, that the atomes or likenesses of bodies, having given their touch upon this *Septum* or *Speculum*, do thence retire back into the concavities, and doe stick (as by chance it happeneth) in some of the inequalities they encounter with there. But if some winde or forcible stream, should break into these caves, and as it were brush and sweep them over; it must follow, that these little bodies will loosen themselves, and begin to play in the vapour which filleth this hollow place: and so floting up and down, come anew to strike and work upon the *Speculum* or fantasie: which being also a soluble body, many times these atomes striking upon it, do carry some little corporeall substance from it sticking upon them: whence ensueth, that they returning again with those tinctures or participations of the very substance of the fantasie; do make us remember, not only the objects themselves, but also that we have thought of them before.

Further we are to know, that all the nerves of the brain, have their beginnings not far from this *Speculum*: of which we shall take a more particular consideration of two, that are called the sixt pair or couple: which pair hath his singularity, that it beginneth in a great many little branches, that presently grow together, and make two great ones contained within one skin. Now this being the property of a sense (which requireth to have many fibers in it, to the end that it may be easily and vigorously stricken, by many parts of the object: lighting upon many parts of those little fibers) it giveth us to understand, that this sixt couple hath a particular nature, conformable to the nature of an externe sense, and that the Architect who placed it there, intended by the severall conduits of it, to give notice unto some part they goe unto, of what passeth in the brain: and accordingly

2.

What causeth us to remember not only the object it self, but also that we have thought of it before.

2.

How the motions of the fantasie, are derived to the heart.

dingly one branch of this nerve, reacheth to the heart; not only to the Pericardium, as Galen thought, but even to the very substance of the heart it self, as later Anatomists have discovered: by which we plainly see how the motion which the senses do make in the *Speculum*, may be derived down to the heart.

4
Of pain and
pleasure.

Now therefore let us consider, what effects the motions so conveyed from the brain, will work in the heart. First remembering, how all that moveth the heart, is either pain or pleasure (though we do not use to call it pain, but grief, when the evill of sense moveth us only by memory, and not by being actually in the sense) and then calling to mind, how pain (as Naturalists teach us) consisteth in some division of a nerve, (which they call *Solutio continui*: and must be in a nerve; for that no solution can be the cause of pain, without sense, nor sense be without nerves; and therefore this solution must needs be in nerves, to have it prove painfull,) we may conclude, that the effect which we call pain, is nothing else but a compression: for although this solution of continuity may seem to be a dilatation; yet in truth, it is a compression in the part where the evill is, which happeneth unto it in the same manner as we shewed (when we spoke of the motion of restitution) it doth to stiffe bodies, that by violence are compressed and drawn into a lesse capacious figure, then their nature affecteth, and return into their own state, as soon as the mastring violence leaveth them at liberty.

Pleasure therefore, must be contrary to this, and consist in a moderate dilatation; for an immoderate one, would cause a compression in some adherent parts; and there would become pain. And conformable to this, we experience, that generally they are hard things which breed pain unto us; and that these which breed pleasure, are oyle and soft; as meates, and odours, which are sweet to the tast and smel; and soft substances, which are gratefull to the touch: the excessse of all which proveth offensive and painfull; so that from the extremity of pleasure, one entrencheth presently upon the confines of pain.

Now then let us consider, how the little similitudes of bodies, which from without do come into the fantasy, must of necessity work there; according to their little power, effects pro-

proportionable to what they wrought first in the outward senses, from whence, they were conveyed to the brain: for the senses (that is the nerves) and the *Septum lucidum*, having both of them their origin from the very substance of the brain, and differing only in degrees of purity and refinement, the same object must needs work like effects in both, compressing or dilating them proportionably to one another: which compression or dilatation, is not pain or pleasure, as it is in the outward sense; but as it is reported to the heart: and that, being the seat of all paines or pleasures wrought in other parts, and that (as it were) dyeth them into those qualities, is not capable of feeling either it self: so that the strokes of any little similitudes upon the fantasy, do make only compressions or dilatations there, not paines or pleasures.

Now their bodies or similitudes, if they be reverberated from the fantasy or *Septum Lucidum*, upon the little roots of the nerves of the sixth couple, which go to the heart, they must needs work there a proportionable impression to what they wrought upon the fantasy, either compressing or dilating it; and the heart being extreamly passive, by reason of its exceeding tendernes and heat; cannot choose but change its motion, at the least in part, if not in whole: and this with relation to two causes: the one disposition of the heart it self; the other, the vehemency of the stroke.

This change of motion and different beating of the heart, is that which properly is called passion: and is ever accompanied with pleasure or with grief, according to the nature of the impression, that either contracteth or dilateth the heart and the spirits about it: and is discovered by the beating of the arteries and of the pulse. Conformable whereunto, Physicians do tell us, that every passion hath a distinct pulse.

These pulses are divided in common, by abundance, or by want of spirits: yet in both kinds, they may have common differences; for in abundance, the pulse may be quick or slow, regular or irregular, equal or unequal: and the like may happen in defect of spirits; accordingly to the motions of the heart, which are their causes. Again, the object by being present or further off, maketh the stroke greater or lesser: and accordingly varieth the motion of the heart.

Let us then call to mind, how we have formerly declared,
E e that

Of passions

6
Of severall
pulses caused
by passions.

that life consisteth in heat and humidity; and that these two joy-
ned together, do make a thing great: and we may conclude
that of necessity the motion which is most lively, must have a
great, full, and large stroak; like the even rolling waves of a
wide and smooth sea; and not too quick or smart, like the brea-
ches of a narrow *Fretum*, agitated by tempestuous winds. From
this, other motions may vary either by excess, or by deficiency:
the first maketh the stroak become smart, violent and thick:
the other slackeneth it and maketh it grow little, slow, weak,
and thin, or seldome.

And if we look into the motions of our heart, we shall see
these three differencies of them follow three severall chief pas-
sions. The first, followeth the passion of joy: the second, the pas-
sion of anger: and the third the passion of grief. Nor need we
look any further into the causes of the severall motions; for
we see that joy and grief, following the stroak of sense, the
one of them must consist in an oyle dilatation: that is, the spirits
about the heart, must be dilated by a gentle, large, great, and
sweet motion, in a moderation between velocity and slownesse.
the other contrariwise, following the stroak of sense in pain, as
the first did in pleasure, must contract the spirits; and conse-
quently make their motion or stroak become little, and deficient
from all the properties we have above set down.

As for anger, the motion following that passion, is, when the
abundance of spirits in the heart is a little checked by the con-
trary stroak of sense, but presently overcommeth that opposi-
tion: and then, as we see a hindred water, or a man, that sud-
dainly or forcibly break through what withstood their motion,
go on with a greater violence then they did, and as it were pre-
cipitately: so the heart, having overcome the contraction,
which the sense made in it, dilateth it self with a fury, and
maketh its motion smart and vehement. Whence also it follow-
eth, that the spirits grow hotter then they were: and according-
ly, it is often seen, that in the scoulding of a woman, and in the
irritation of a dog, if ever now & then, one thwart them, and in-
terpose a little opposition, their fury will be so sharpened and
heightned, that the woman will be transported beyond all li-
mits of reason, and the dog will be made mad with nothing
else done to him, but angring him at convenient times: and
som

Some men likewise, have by slight opposition, iterated speedily upon them before their spirits could relent their vehement motion (and therefore, must still encrease it) been angred, into feavers.

This passion of anger, seemeth almost to be solitary on the side of excess beyond joy : which is, as it were the standerd and perfection of all passions ; as light or whitenesse, is of all colours : but on the other side, of deficiency, there are several middle passions, which participate more or lesse of joy and greif: as particularly those two famous ones, which govern mans life, *Hope* and *Fear*. Concerning which Physitians tell us, that the pulse or beating of fear, is quick, hard, and unequal : unto which I conceive we may safely adde, that it must also be small and feeble; the perfection of joy, decreasing in it on one side, to wit, from greatnesse and largenesse ; but not intirely; so that a kind of quicknesse supplyeth in part the other defect. Hope on the other side, is in such sort defective from joy, that nevertheless it hath a kind of constancy, and moderate quantity, and regularity in its motion: and therefore is accounted to be the least hurtfull of all the passions, and that which most prolongeth mans life. And thus you see how those motions, which we call passions are engendered in the heart, and what they are.

Let us then in the next place consider, what will follow in the rest of the body, out of these varieties of passion once rayfed in the heart, and sent into the brain. It is evident, that according to the nature and quality of these motions, the heart must needs in every one of them, voyd out of it self into the arteries a greater or lesser quantity of blood, and that in divers fashions: and the arteries which lie fittest to receive these sudden egestions of blood are those which go into the brain : whose course being directly upwards, we cannot doubt, but that it is the hottest and subtillest part of the blood, and the fullest of spirits, that flyeth that way. These spirits then running a long and perplexed journey up and down in the brain, by various meanders and anfractuosities, are there mingled with the humide steam of the brain it self, and are therewith cooled ; and do come at the last, to smooke at liberty in the hollow ventricles of the brain, by reeking out of the little arteriall branches, that do weave the *plexus choroides*, or net we spoke of erewhile : and

Of several other effects caused naturally in the body by passions,

they being now grown heavy, do fall (by their naturall course) into that part or proceſſe of the brain, which is called *medulla ſpinalis*, or the marrow of the back bone : which being all beſet by the nerves that run through the body, it cannot happen otherwiſe, but that theſe thickened and deſcending ſpirits, muſt either fall themſelves into thoſe nerves, or elſe preſſe into them other ſpirits which are before them, that without ſuch new force to drive them violently forwards, would have ſlided down more leiſurely. Now, this motion being downwards, and meeting with no obſtacle till it arrive unto its utmoſt periode that way, the loweſt nerves are theſe, which naturally do feel the communication of theſe ſpirits firſt.

But it is true, if the flowing tide of them be great and plentifull, all the other nerves wil alſo be ſo ſuddenly filled, upon the filling of the lowermoſt, that the ſucceſſion of their ſwellings, will hardly be perceptible : as a ſudden and violent inundation of water, ſeemeth to riſe on the ſides of the chanell, as it doth at the mill-damme ; though reaſon aſſureth us it muſt begin there, becauſe there it is firſt ſtopped.

On the contrary ſide, if the ſpirits be few, they may be in ſuch a proportion, as to fill only the lower nerves, and to communicate little of themſelves to any of the others. And this is the caſe in the paſſion of fear: which being ſtored with fewer ſpirits, then any other paſſion that cauſeth a motion in the body, it moveth the legs moſt ; and ſo carrieth the animal that is affrayd, with violence from the object that affrighteth him. Although in truth, it is a faint hope of eſcaping, mingled with fear, which begetteth this motion : for when fear is ſingle, and at its height, it ſtoppeth all motion by contracting the ſpirits, and thence is called *ſtupor*; as wel as grief, for the ſame reaſon: and accordingly we ſee extream Cowards in the extremity of their fear, have not the courage to run away, no more then to defend or help themſelves by any other motions.

But if there be more abundance of ſpirits ; then the upper parts are alſo moved, as wel as the legges ; whoſe motion contributeth to defense: be it the brain it ſelf, and the ſenſes which are in the head, being the firſt in the courſe of this flood of ſpirits, that is ſent from the heart to the head ; it is impoſſible but that ſome part of them, ſhould be preſſed into the nerves of thoſe ſenſes ;

senses; and so will make the animal vigilant and attentive to the cause of its feare or grieve.

But if the feare be so great, that it contracteth all the spirits, and quite hindereth their motion (as in the case we touched above) then it leaveth also the nerves of the senses destitute of spirits; and so by too strong apprehension of a danger, the animal neither seeth nor apprehendeth it: but as easily precipiteth it selfe into it, as it happeneth to avoid it; being meerly governed by chance; and may peradventure seeme valiant, through extremity of feare.

And thus you see in common, how all the natural operations of the body, doe follow by natural consequence out of the passions of the minde: without needing to attribute discourse or reason, either to men or beasts to perform them. Although at the first sight, some of them may appeare unto those that look not into their principles & true causes, to flow from a source of intelligence: whereas it is evident by what we have layed open, they all proceed from the due ranging and ordering of quantitative parts, so or so proportioned by rarity and density. And there is no doubt, but who would follow this search deeply, might certainly retrace the reasons of all those externall motions which we see use to accompany the severall passions in Men and Beasts. But for our intent, we have said enough, to shew by what kind of order and course of nature, they may be effected (without confining our selves over scrupulously to every circumstance that we have touched) and to give a hint, whereby others that will make this inquiry their taske, may compile an intire, and well grounded, and intelligible doctrine of this matter.

Only we will adde one advertisement more; which is that these externall motions caused by passion, are of two kinds: for some of them are as it were the beginnings of the actions, which nature intendeth to have follow out of the passions that cause them: but others are not onely bare signes of passion that produce them, and are made by the connexion of parts unnecessary for the maine action that is to follow out of the passion, with other parts that by the passion are necessarily moved: as for example, when an hungry mans mouth watereth at the sight of good meate, it is a kinde of beginning of eating, or of prepa-

ration for eating: for when we eate, nature draweth a moyſture into our mouth, to humectate our meat, and to convey the taſt of it into the nerves of the tongue, which are to make report of it unto the braine: but when we laugh, the motion of our face aymeth at no further end, and followeth only by the connexion of thoſe muſcles, which draw the face in ſuch a ſort, unto ſome inward parts, that are moved by the paſſion, out of which laughing proceedeth.

8.
Of the Dia-
phragma:

But we muſt not leave this ſubject without ſome mention of the diaphragma: into which the other branch of thoſe nerves, that are called of the ſixt conjugation, doth come: for the firſt branch we have ſaid goeth into the heart, and carrieth thither the objects that come into the braine: and this, we ſhall find, carrieth back to the braine the paſſion or motion, which by the object is rayſed in the heart. Concerning this part of our body, you are to note, that it is a muſculous membrane, which in the middle of it hath a ſinewy circle; whereunto is faſtned the caſe of the heart, called the Pericardium. This Diaphragma is very ſenſible, receiving its vertue of feeling from the above mentioned branch of the ſixt couple of nerves: and being of a trembling nature, is by our reſpiration kept in continuall motion: and flappeth upon all occaſions, as a drum head would do, if it were ſlack and moyſt; or as a ſayle would do, that were brought into the wind.

Out of this deſcription of it, it is obvious to conceive, that all the changes of motion in the heart, muſt needs be expreſſed in the Diaphragma. For the heart beating upon the Pericardium, and the Pericardium being joyned to the Diaphragma; ſuch joggs and vibrations muſt needs be imprinted and echoed there, as are formed in the heart: which from thence, cannot chooſe but be carried to the braine by the ſixt couple of nerves. And thus it commeth about, that we feel and have ſenſation of all the paſſions, that are moved in our heart. Which peradventure is the reaſon, why the Greeks do call this part *φρεν*; and from it derive the verbe *φρονειν*, that in Latin ſignifyeth *Sapere*, with us, to ſavour or to like: for by this part of our body, we have a liking of any object, or a motion of inclination towards it: from whence *σφρονειν* is derived, by compoſition of *φρονειν*, with *σφ*: for a prudent man is he, that liketh, & is moved

moved to compasse wholesome & good things. Which Etymology of the word, seemeth unto me more naturall, then from the phrenesy, from whence some derive it; be cause a great distemper or inflammation in the Diaphragma, often causeth that disease.

Now, because the objects is conveyed from the brain to the heart some part of its way, by the same passage, as the motion of the heart is reconveyed back to the brain, it must of necessity follow, that who is more attentive to outward sense, doth lesse consider or reflect upon his passion; and who is more atentive to observe, and be governed by what passeth in his heart, is lesse wrought upon by externall things. For if his fantasy draweth strongly unto it, the emanations from outward agents upon the senses, the fireame of those emanations will descend so strongly from the over filled fantasy into the heart, that it will hinder the ascent of any fewer and weaker spirits by the same pipe. But if the current do set strongest upwards from the heart by the Diaphragma to the brain, then it will so fill the pipe by which it ascendeth, that little of a weaker tyde, can make a contrary cbbly water in the sam channell.

And by this meanes, nature effecteth a second pleasure or paine in a living creature, which moveth it (oftentimes very powerfully) in absense of the primary object: as we may observe, when thinking of any pleasing or displeasing action, we find about our heart a motion which inticeth us to it, or averteth us from it: for as the first pleasure was occasioned by the stroak, which the object applyed to the outward sense, made upon the fantasy (which can judge of nothing without being stricken by it) so the second pleasure springeth from the spirits moved in the heart, by messengers from the brain, which by the Diaphragma do rebound a stroak back again upon the fantasy. And from hence it proceedeth, that memory delighteth or afflicteth us; and that we think of past things with sweetnesse or with remorse: and thereby assuefaction is wrought in beasts, as farre as the appetitive part doth contribute thereunto, to perfect what was begun in their cognoscitive part, by the ingression of corporeal specieses into their fantasy, in order to the same effect, as we have touched before.

But now let us examine, how so small a quantity of a body as commeth from an object into our sense, can be the cause of so great

9
Concerning
pain and pleasure
caused by
the memory of
things past.

10
How so small
bodies as a-
tomes are, can
cause so great
motions in the
heart.

a motion about our heart. To which purpose we are to remember, that this motion is performed in the most subtile and thin substance, that can be imagined: they are the vitall spirits, that do all this work; which are so subtile, so agile, and so hot, that they may in some sort be termed fire. Now if we reflect how violent fire is, we need not wonder at the suddaine and great motion of these passions.

But we must further take notice, that they are not in the greatest excessse, but where the living creature hath been long inured and exercised unto them, either directly or indirectly: so that they arrive not to that pitch so much out of the power of the agent, as out of the preparation and disposition of the patient; as when cold water hath been often heated by extinguishing red hot irons in it, after some repetitions a few quenchings will reduce it from cold to boyling, that at the first would scarce have made it lukewarme: and accordingly we see a hart, that for a long time hath loved, and vehemently hath desired enjoying, is transported in a high degree, at the least sight and renuance of stroaks from its beloved object; and is as much dejected, upon any the last deprivation of it: for to such an object, the living creature is hurried away by a force much resembling the gravity or celerity of a dense body, that is set on running down a steep hill; unto which, the onely taking away of a weake let or the least stop, giveth a precipitate course, not out of the force of what is done to it, but out of the force which was formerly in the thing, though for the present it lay there undiscovered: and so likewise in these cases, the object rather giveth the occasion of the violent motion, then the force or power to it.

How the vitall spirits sent from the brain, doe run to the intended part of the body without mistake.

These things being thus determined, some peradventure may ask, how it commeth to passe, that the spirits which cause motion, being sent on their errant by the braine, do alwayes hit the right way, and light duly into those very finewes, which move the living creature according as it is requisite for its nature? Since all the passages are open, what is it that governeth them, so as they never mistake, and the animal is never driven towards harme instead of flying from it? Who is their guide in these obscure paths? But it were to impute ignorance to the maker, to think that he framed all the passages alike, and so every one of them,

them, promiscuously apt to receive into them, all sorts of spirits, howsoever they be moved: and therefore, we may assure our selves that since in these diversities of occasions, there are likewise divers kinds of motions from the heart; either there is proportionable unto them, divers kinds of passages fit to receive and entertaine the spirits according to the condition they are in, so as the passages which are ajusted to one kind of spirits; will not admit any of an other nature: or else the first motions of liking or disliking in the heart, which (as we have said) do cause a swelling or a contraction of it against this or that part; doth stop and hinder the entrance of the spirits into some sinews, and doth open others, and driveth the spirits into them: so as in the end, by a result of a chaine of swellings and contractions of severall parts successively one against an other, the due motions of prosecution or aversion are brought about.

As for example; an object that affecteth the heart with liking, by dilating the spirits about the heart, sendeth some into the optick nerves, and making the living creature turne his eye towards it and keep it steady upon what he desireth: as contrariwise, if he dislike and feare it, he naturally turneth his eye and head from it. Now, of this motion of the eye and head, may depend the running to the thing in one case, and the running from it in the other: for the turning of the neck one way, may open a passage for the spirits into those sinewes, which carry the rest of the body towards the object: and the turning of it to the other side, may open other sinewes, which shall work a contrary effect, and carry the animall from the object: and the moving of those sinewes, which at the first do turne the neck; doth proceed from the quality and number of the spirits that ascend from the heart, and from the region of the heart from whence they are sent: according to the variety whereof, there are divers sinewes fitted to receive them.

To make up w^{ch} discourse, we may call to mind, what we have said a little above concerning the motions caused in the external parts of the body, by passion moving within: as when feare mingled with hope, giveth a motion to the legs, anger to the armes & hands, and all the rest of the body as well as to the legs; and all of them, an attention in the outward senses; which nevertheless perverteth every one of their functions, if the passion be in extremity.

And

And then surely, we may satisfie our selves, that either this, or some way like it (which I leave unto the curious in Anatomy to settle with exactnesse; for it is enough for my intent, to shew in grosse how these operations may be done, without calling in some incomprehensible qualities to our ayd) is the course of nature in motions, where no other cause interveneth, besides the object working upon the sense: which all the while it doth, it is the office of the eye of fantasie or of common sense, to lie ever open; still watching to observe what warnings the outward senses do send unto him; that accordingly he may direct and change the motions of the heart, and of the whole body.

It
H w men are
blinded by
passions.

But if the object do make violent impressions upon the sense; and the heart, being then vehemently moved, do thereupon send abundance of spirits up to the brain; this multitude of spirits thronging upon the common sense, oppresseth it (as we have already said) in such sort, that the notice which the sense giveth of particular circumstances, cannot prevaile to any effect in the brain: and thus by the misguidance of the heart, the work of nature is disordered: which when it happeneth, we expresse in short, by saying that passion blindeth the creature, in whom such violent and disorderly motions have course; for passion is nothing else, but a motion of the blood and spirits about the heart; and is the preparation or beginning of the animals working; as we have above particularly displayed.

And thus you see in common, how the circuit is made from the object to the sense; and from it by the common sense and fantasie, to the heart; and from the heart, back again to the brain; which then setteth on work those organes or parts the animal is to make use of in that occasion: and they either bring him to, or carry him from the object, that at the first caused all this motion, and in the end becommeth the period of it.

THE SIX AND THIRTIETH CHAP.

Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing.

IN the last Chapter the foundations are layd, and the way is opened, for the discovering how all operations which proceed from nature and passion, are performed among living creatures: and therefore, I conceive, I have there by sufficiently complied with the obligation of my intencion, : which is but to expresse and shew in common, how all the actions of sensible bodies may be reduced to locall motion, and to materiall application of one body unto another, in a like manner (though in a different degree) as those motions which we see in liveliest bodies. Yet because among such animals as passe for irrational, there happen some operations of so admirable a straine, as resemble very much the highest effects which proceed from a man: I think it not amisse, to give some further light, by extending my discourse to some more particulars then hitherto I have done; whereby the course and way how they are performed, may be more clearly and easily looked into: and the rather, because I have met with some men, who either wanting patience to bestow on thoughts of this kind so much time as is necessary for the due scanning of them; or else through a promptitude of nature, passing swiftly from the effect they look upon in grosse, to the most obvious seeming cause; do suddenly and strongly resolve, that beasts use discourse upon occasions and are endewed with reason.

The order and connexion of the subsequent Chapters.

This I intend not to do quite in particular, for that were to write the History of every particular animal: but will content my selfe with touching the causes in common; yet in such sort, that the indifferent Reader may be satisfied of a possibility, that these effects may proceed from material causes: and that I have pointed out the way, to those who are more curious, and have the patience and leisure to observe diligently what passeth among beasts, how they may trace these effects from step to step, untill at length they discover their true causes.

To

To begin then ; I conceive we may reduce all those actions of beasts, which seem admirable, and above the reach of an irrational animal, unto three or four severall heads. The first may be of such, as seeme to be the very practice of reason, as doubting, resolving, inventing, and the like. The next shall be of such, as by docility or practice, beasts doe often times arrive unto. In the third place, we will consider certaine continue actions of a long tract of time, so orderly performed by them, as that discourse and rational knowledge seem clearly to shine through them. And lastly, we will cast our eye upon some others, which seem to be even above the reason that is in man himselfe, as the knowing of things which the sense never had impression of before, a prescience of future events, providences, and the like.

2
From whence
proceedeth the
doubting of
beasts.

As for the first : the doubting of beasts, and their long wavering sometimes between objects that draw them severall wayes, and at the last their resolving upon some one of them, and their steady pursuance of that afterwards ; will not be matter of hard digestion to him, that shall have well relished and meditated upon the contents of the last Chapter : for it is evident, that if severall objects of different natures do at the same time present themselves unto a living creature, they must of necessity make divers impressions in the heart of it, proportionable unto the causes from whence they proceed : so that if one of them be a motion of hope, and the other be of feare ; it cannot choose but follow thence, that what one of them beginneth, the other will presently break off : by which means it will come to passe, that in the beasts heart there must needs be such waverings, as we may observe in the sea, when at the beginning of a tide of flood, it meeteth with a banke that checketh the coming in of the waves, and for a while, beateth them back as fast as they presse upon it ; they offer at getting over it, and by and by retire back againe from the steepnesse of it, as though they were apprehensive of some danger on the other side ; and then againe attempt it a fresh : and thus continue labouring, one while one way, another while another ; untill at the length the flood increasing, the water seemeth to grow bolder, and breaketh amaine over the banke, and then floweth on, till it meeteth with another, that resisteth it, as the first did : and thus you see, how the sea can doubt

doubt and resolve, without any discourfing. In the like manner it fareth with the heart of a beaft (whose motions do fteer the reft of the body) when it beateth betwixt hope and fear, or between any other two contrary paffions, without requiring any other principles from whence to deduce it, then thofe we have already explicated.

But now to fpeak of their invention; I muft confefle, that among feverall of them, their appeareth fo much cunning in laying of their plots (which when they have compaffed, they seem to grow carelefle, and to unbend their intention, as having obtained what with earneftneffe they defired) that one might think they wrought by design, and had a diftinct view of an end; for the effecting of which, they ufed difcourfe to choofe the likeliest means.

³ Concerning the invention of Foxes and other beafts.

To this purpose the subtilties of the fox are of moft note. They fay he ufeth to lie as if he were dead; thereby to make hens and ducks come boldly to him. That in the night when his body is unfeen, he wil fix his eyes upon poultry, and fo make them come down to him from their roof. That to rid himfelfe of his fleas that afflict him in fummer, he will fink his body by little and little into the water, while the fleas creep up to his head (to fave themfelves from drowning) and from thence to a bough he holdeth in his mouth; and will then swim away, leaving them there. That to Cofen the badger of his earth, he will piffe in it; as knowing that the rank fmell of his urine, will drive the other cleanlier beaft to quit it. That when dogges are close upon him, and catching at him, he will piffe upon his taile, and by firking that up and down, will endeavour (you may beleeve) to make their eyes smart, and fo retard their purfuit, that he may efcape from them.

And their are particular ftories, that exprefle yet more cunning then all thefe: as of a fox, that being fore hunted, hanged himfelf by the teeth among dead vermin in a warren; untill the dogges were paffed by him, and had loft him. Of another, that in like diftrefle, would take into his mouth a broom bush growing upon a fteep cliffe on the fide hand near his den (which had another way to it, eafie enough of acceffe) and by help of that, would fecure caft himfelf into his

his hole; whiles the dogges that followed him hastily, and were ignorant of the danger, would break their necks down the rockes.

It is said, that in Thracia, the Country-people so know whether the rivers that are frozen in the winter will bear them, or no, by marking whether the foxes venture boldly over them, or retire after they have layed their eares to the Ice, to listen whether or no they can hear the noyse of the water running under it: from whence you may imagine they collect, that if they heare the current of the stream, the Ice must needs be thin; and consequently dangerous to trust their weight unto it.

And to busie my self no longer with their subtilties, I will conclude with a famous tale of one of these crafty animals; that having killed a goose on the other side of the river, and being desirous to swim over with it, to carry it to his den, before he would attempt it (least his pray might prove too heavy for him to swim withall, and so he might lose it) he first weighed the goose with a piece of wood, and then tryed to carry that over the river, whiles he left his goose behind in a safe place; which when he perceived he was able to do with ease, he then came back again and ventured over with his heavy bird.

They say it is the nature of the Jacatray to hide it self, and imitate the voice of such beasts, as it useth to prey upon; which maketh them come to him, as to one of their own fellows; and then he seisseth upon them and devoureth them.

The Jaccall that hath a subtile sent, hunteth after beasts, and in the chase, by his barking guideth the lyon, (whose nose is not so good) till they overtake what they hunt; which peradventure would be too strong for the Jaccall; but the Lyon killeth the quarry, and having first fed himself, leaveth the Jaccall his share: and so between them both, by the ones dexterity, and by the others strength they get meat for nourishment of them both.

Like stories are recorded of some fishes. And every day we see the invention of beasts to save themselves from catching: as hares, when they are hunted, seek alwaies to confound the sent; sometimes by taking hedges, other whiles waters; sometimes running among sheep and other beasts of stronger sent; some-

Sometimes making doubles, and treading the same path over and over; and sometimes leaping with great jumpes hither and thither, before they betake themselves to their rest; that so the continuatenesse of the sent may not lead dogges to their forme.

Now to penetrate into the causes of these and of such like actions; we may remember, how we shewed in the last Chapter, that the beating of the heart worketh two things: the one is, that it turneth about the species, or little corporeities (streaming from outward objects) which remain in the memory: the other is, that it is alwaies pressing on to some motion or other: out of which it hapneth, that when the ordinary waies of getting victuals, or of escaping from enemies, do fail a creature whose constitution is active; it lightneth sometimes (though peradventure very seldome) upon doing something, out of which the desired effect followeth; as it cannot choose but fall out now and then, although chance onely do govern their actions: and when their action proveth succesfull, it leaveth such an impression in the memory, that whensoever the like occasion occurreth, that animal will follow the same method; for the same specieses do come together from the memory into the fantasie. But the many attempts that miscarry, and the ineffectuall motions which straits do cast beasts upon, are never observed, nor are their any stories recorded of them: no more then in the Temple of Neptune, were kept upon the registers, the relations of those unfortunate wretches, who making vowes unto that God in their distresse, were neverthelasse drowned.

Thus peradventure, when the fox seeth his labour in chasing the hen, to be to no purpose; and that by his pursuit of them, he driveth them further out of his reach; he layeth himself down to rest, with a watchfull eye, and perceiving those silly animals to grow bolder and bolder, by their not seeing him stir, he continueth his lying still, untill some one of them commeth within his reach, and then on a sudden, he springeth up and catcheth her: or peradventure some poultry might have strayed within his reach whiles he was a sleep, and have then wakened him with some noise they made: and so he hapned to seise upon one of them, without either designe or paines taking beforehand.

4.
Of foxes that catch hens by lying under their roost, & by gazing upon them.

hand: by such degrees he might chauce to catch one the next time: and they being settled in his memory, together with the effect; it happened that another time when hunger pressed him, and sent up to his brain like spirits unto those which ascended thither whiles he lay watching the hens; these spirits brought the other from his memory into the fantasie (in such sort as we have shewed in the last Chapter) and so drove him to the same course, untill by frequent repetitions, it became ordinary and familiar with him: and then they that look onely upon the performance of the artifice, are apt to infer the discourse & a delign of reason, out of the orderly conduct of it.

But how can we conceive the fox hath judgement to know when the hen is come within his leap, and accordingly offereth nor at her till then; unlesse we resort to some other principles, then what is yet declared? The answer unto this objection I think will not be hard to finde; for if the motion, which the presence of the object maketh in the heart be proportioned out by nature (as there is no doubt but it is) it will not be so great and powerfull, as to make the fox leap at it, untill it be arrived so near him, that by his nimbleness he can reach it; and so without any ayme, further then by the meer flux of his passion conveniently raised, he doth the feat: but if his passion be too violent, it maketh him misse his ayme; as we may frequently observe both in men and beasts: and particularly, when fear presseth either of them to leap over a ditch, which being too broad, he lighteth in the midst of it.

The same watchfulness and desire to have the pullen, that sit upon a tree out of his reach, maketh him fix his eyes upon them, when they are at roost: and at length either the brightness and sparkling of them dazleth the birds, and maketh them come down to them, (as flies do in the night about the flame of a candle; or as fishes do to a light in a boats head;) or else they are affraid; and their fear increasing, their spirits return to the heart, which thereby is oppressed, and their outward parts are bereaved of strength and motion; from whence it followeth necessarily, that their footing looseth, their hold fast, and they tumble down half dead with fear, which happeneth also frequently to cats, when they look wistly upon little birds, that sit quietly. Or peradventure, their fear maketh them giddy;

as when some man looking downe a precipice from a dangerous standing, he falleth by the turning of his braine, though nothing be behind him to thrust him forwards. Or it may be, some steame commeth from the Fox, which draweth such creatures to him; as it is reported that a great and very poysonous Toade will do a Weasell, who will run about the Toade a great while, and still make his circle lesser and lesser, till at length he perisheth in the center, where his foe sitteth still, and draweth him to him: which he doth in such sort, as animated Mercury will draw leaf-gold duly prepared, or as the load-stone attracteth Iron: and yet it is apparent, the Weasell cometh not with his good will; but that there are some powerfull chaines, steaming from the body of the Toade, which pluck him hither against his liking; for by his motions and running, he will expresse the greatest feare that can be.

The method which Foxes do practice, to ridde themselves of their fleas (if it be true) is obvious enough for them to fall upon; for in Summer, their fleas together with their thick furred coate, cannot choose but cause an exceeding great itching and heate in their bodies; which will readily invite them to goe into the water to coole themselves; as the Merchants at the Isles of Zante and of Cephalonia told me (when I was there) it was the custome of our English Dogges (who were habituated unto a colder clime) to runne into the Sea in the heate of Summer, and lie there most part of the day, with onely their noses out of the water, that they might draw breath, and would sleep there with their heads layed upon some stone, which raised them up, whiles their bodies were covered with the Sea: and those Dogs which did not thus, would in one Summer usually be killed with heat and Fleas.

Now when the Fox feelet the ease that the coolnesse of the water affordeth that part of him which sitteth in it, he goeth further and further; yet would not put himselfe to swim, which is a labour, and would heat him, and therefore he avoideth it; so that whiles he thus cooleth himselfe in some shady place (for it is naturall unto him, in such an occasion, to resort unto the coole shade, rather then to lie in the Sunne) and in such there being for the most part some boughes hanging over the water, it happeneth naturally enough, that he taketh

^S
From whence
proceedth the
Foxes inven-
tion to ridde
himselfe of
Fleas:

some of the lowest in his mouth, to support him, and save him the labour of swimming, whiles he lyeth at his ease, soaking and cooling himselfe in the River. By which meanes it cometh to passe, that the fleas finding no part of him free from water, do creep up to the bough to rescue themselves from drowning: and so, when he is cooled enough, he goeth away and leaveth them there. In all which finding a benefit and satisfaction, whensoever the like occasion bringeth those species, from his memory into his fantasie, he betaketh himselfe to the same course, and therein finding his remedy, at length it groweth familiar to him.

In the like manner, Thales his mule, that was heavily loaden with Salt, happening to stumble, and to fall in a River she was going over, the Salt melted by the water soaking into the sacks and so she was eased of her burden; which successe made her, whensoever she came to a River, and was troubled with her loading, she would lie downe in the water; and could not be reclaymed from it, till they charged sacks of wooll upon her back, which growing heavier by their imbibing of water, weaned her from her former crafty habit. By which it is apparent, that it was memory and not judgement, which made her for a while behave her selfe so subtilly.

An explication of two other inventions of Foxes.

For the Foxes driving the Badger from his earth, you will not think it needfull to allow him a forecast and designe in pissing in it: but as it is naturall for him, to rest in a place that he meeteth with fit for that purpose; so it is for him to pisse in it, if the list takes him whiles he is there; which in all liklyhood it will, if he stay any time there, and give a relaxation to all his parts by sleep.

And when he pisseth in his taile, and shaketh it in the Doggs eyes, it is evident that feare, not craft causeth this effect; for it awayleth him little, and therefore is not likely to proceed from judgement. And of the other, it is a naturall effect in all beasts (when it is violent) to contract their tailes between their legs, and to make their urine conie from them, (by compressing the spirits in their heart, which should support their outward parts, and strengthen their splinctor muscle) which their being snapped at and seised upon by the Doggs, shaketh from their bushy tailes (fit to retaine it) and then lighting in the Doggs eyes the

the acrimony of it hurteth them, and maketh them shut their liddes.

The story (if it be true) of the Fox, that to save himself from the Dogs that he heard following him in full cry, did hang by his teeth among dead vermin in a warren, is a very strange one I confesse : but it is conceivable, how fear and wearinesse might cause him to seek a shelter to hide himself : and in so plain a tract of ground as warrens use to be in, without any bush or hill to have recourse unto for reliefe, there appearing nothing but a gallows hanging full of vermin ; his fantasie might be moved (he being able to run no further) to thrust himself among, those dead bodies, that he saw rested quietly : and having no way to mingle himself with them, but hanging by his teeth ; he might continue in that posture, till the Dogs not suspecting him in the ayr, might run under him, and overshoot the sent : which whiles they cast about to recover, by running to beat the next wood or shelter in view (as is their custome in losses of their chance ; unto which they are brought by their masters hunting them in that method at the first) the wily animal stealeth another way, and recovereth himself.

This overrunning of the sent by Dogs in the earnestnesse of their chace, putteth me in mind of Montagues argument, our of which he will infer, that Dogs use discourse, and do make syllogismes in their hunting : for (saith he) when they have followed their chace down a Lane, that at length divideth it self into three others ; they will carefully smell at the first, and at the second, and not finding that it hath gone in either of those, they boldly run upon the third, without ever laying their Noses to the ground ; as being assured by their discourse and reason, that since it went not in the two first, and their being but one remaining, it must of necessity have gone there.

7
Concerning
Montagues
argument to
prove that
Dogs make
syllogismes,

But this needeth no other cause, then that their eagernesse of hunting, hauing made them overshoot the sent, (which for a while remaineth in their noses, after they are parted from the object that caused it) they cast back again (as they are accustomed to be made to do in like occasions by the hunters that train them up) and with their noses they try the ground all the way they go ; till comming neer where the chace went indeed, the

sent striketh their Noses (that by this time are grown empty of it) before they come at the place : and then they run amain in pursuit of it with their heads held up (which is their convenientest posture for running) and all the way, the sent filleth them at that distance without their needing to smell upon the Earth, to fetch it from thence.

8
A declarati-
on how some
tricks are per-
formed by
Foxes, which
seem to argue
discourse.

That Fox which used to cast himself by the advantage of a bough into his Den, was so closely pursued by the Dogs the first time he ventured upon this feat, that he had not time to go into his Earth (his ordinary retreat, when he is nearer it) by the easie and accessible way ; but on the one side, to get thither being strong in his fantasie, and on the other side, the precipice which he had often seen, coming likewise thither from his memory ; these two concurring could not choose but make him go warily thither : and in so dangerous a leap, it is natural for him, to help himself by any thing in the way that can advantage him : which happening to be by catching in his mouth a bough that hung over his Den, (the onely suddain means he had to take hold of any thing) and from thence taking as it were a new rise for a second leap, he findeth himself in security : whiles the Dogs unacquainted with the place, run violently on, as in the rest of their chace : and so are upon the brim of the precipice, before they perceive it ; and then it is too late for them to stop their course, and consequently, they break their necks. Which mischief to them the Fox needeth not have in his designe, and accordingly tolleth them that way ; but chance begetting this deliverance of him at the first, when he was so hard pressed, his memory teacheth him to follow the same course, whosoever the like occasion occurreth.

But how many Foxes do there perish in attempts, which if they succeeded, would have been accounted by slight judgers to be notable subtities ; but miscarrying are esteemed tumultuary motions without designe, caused by that animals fantasie and spirits, when he is in extremity ? I remember how upon a time, when I was hunting one, he being hard set, and but a little before the Dogs and the Hunters, caught in his mouth the bough of a crooked Ash-tree, he run up a pretty way ; which being in a hedge, he thereby hung down along the side of the

the hedge, and when we struck him over the ribs with our poles, he would not quit his hold, (so strongly the feare of the Dogs wrought in his fantasie) till greater blowes knocked him on the head. Which sheweth evidently that this action, was the effect of chance pressing his fantasie to do something; and not any reason or discourse providing for his safety: as we have already said upon occasion of the others hanging among the dead vermine in the warren.

Those in Thracia, that will not goe over a frozen River, when the Ice is too thin to beare them, are by there memory, not by their judgement taught to retire; for at other times they have been wetted, when they have heard the noise of the streame running under the Ice: or the very running of the water calleth the specieses of swimming out from their memory, along with it into their fantasie (neither of which is pleasant to them in the winter) and so disliking the noise for the other effects sake, that used to accompany it, they avoyd that which begetteth it, and so retire from the River. And the reason of their listning to the noise, proceedeth from the spirits, that their passion upon apprehension of a danger presseth into the nerves of their senses, as well as into the other nerves of their braines; which accordingly maketh them so vigilant, and attentive, then to outward objects and motions.

That the Jaccatray, or Hayæna, when he is hungry, should have his fantasie call out from his memory, the Images of those Beasts, which use to serve him in that occasion, is the ordinary course of nature: and that together with those Images, there should likewise come along the actions and sounds which used to accompany them, and are lodged together with them in the memory, is also naturall; then, as little strange it is, that by his owne voyce he should imitate those sounds, which at that time doe so powerfully possesse his imagination: and having a great docility in those Organs which forme the voice, like a Parrat he representeth them so lively, that the deceived beasts flock to him, and so are caught by him: which at the first happeneth by chance, but afterwards by memory, and groweth familiar to him.

Nor can we imagine, that the Jaccall hath a designe of serving the Lyon; but his nature being (like a Dog) to bark when

9
Of the Jaccatray, invention in calling beasts to himselfe.

10
Of the Jaccall's designe in serving the Lyon,

he feeleth the sent hot (which he pursueth for his own sake) the Lyon that dwelleth in the same woods with him, meeteth with the noise, and followeth it; and peradventure would kil the Jaccal himself, as well as what he hunteth, if he could overtake him : but he being too nimble for the Lyon, keepeth out of his reach ; till having wearied the beast, he chaceth the Lyon that followeth by the cry, commeth in when he is at a-bay, and soon teareth in pieces what the other had not strength enough so suddainly to master, and feedeth himself upon the Quarry till he be full. All this while the Jaccal dareth not come neer the Lyon but standeth at a distance with fear wayting till he have done, and then after he is gone away, he taketh his turn to feed upon what his surly master hath left.

II
Of several
inventions of
Fishes.

The like reason it is probable we might find out among those Fishes that serve one another, if we had the conveniency of observing particularly how they behave themselves ; as when the Whale hath service from his litle guide (if the report be true, which is a necessary circumstance to be inserted in every such tale) and others of the like stain.

The subtlety of the Torpedo (who hideth himself in the mud to benum Fishes, that may afterwards serve him to feed upon) will not require to have its origine from reason, and be done by designe ; when you shall consider it is natural for such cold Creatures to immud themselves : and then the Fishes that swim within the reach of his benumbing faculty, will be stayd and frozen there : which because they see him not, they apprehend not, till it be too late for them to avoid it : and then when the Torpedo commeth out, he feedeth upon what he findeth lying ready in his way.

II
A discovery
of divers
things don by
hares, which
seem to argue
discourse.

And in like manner, the Scuttle-fish, when he is in straights of being taken by the Fisherman, casteth out a blacknesse that is within him, and so making the water become like Inke, he oftentimes escapeth their hands in the darkned Element : which ariseth from no discourse of his, but fear maketh him voyd this liquor that is in him (as it made the Fox voyd his Urin) and in consequence thereunto, the effect followeth.

Lastly, when Hares do use those meanes we have mentioned to confound the sent, and to save themselves from the dogs that

that hunt them, we may observe, that they take therein the readiest wayes, and the most obvious unto sense, to avoid the evill they flie from. For what can be more direct to that effect, then to hide themselves in hedge bottomes, or in woods? Or to swim over a River, when that is the most immediate way to runne from the Doggs? And when they are in a plaine, where there is no other shelter but flocks of sheep or heardes of deer, what can be more naturall, then for them to hide themselves among them, and run along with them, till the cry of the approaching hounds fright them away, whilst those tamer beasts abide it neerer?

Their doublings backward and forward, may proceed from their feare, that diverteth them still from the way they are in at present, till the Doggs comming neer, do put the hare out of those waverings, and do make her run straight away: for they never double but when they are a great way before the Doggs, and do not hear them. Or else it may be, that not hearing or seeing the Doggs, their feare may be almost passed; and then the agitation which their spirits are in, governeth the motions of their body, and will not let them rest untill they be more appeased, (as you see weary people, that at their first ceasing from running, cannot sit still: the like of which happeneth also frequently in the motions of joy or of anger) and so it maketh them walk backwards and forwards, in a pace proportionate to the agitation of the spirits within: and sometimes those moved spirits doe make them bound and leap to and fro (like the loafe with quick-silver, we have hereto fore spoken of) as they issue from the heart by pulses and stroakes; which happeneth when they begin to settle towards rest. Or else peradventure their forme is so framed, that if they should get into it otherwise then by a jump, they would disorder some part of it, and so be unfenced and a cold, or otherwise at unease during their repose: and therefore their jumping to and fro, before they leap plump in, is to take their aime; not much unlike to Doggs, turning about severall times before they lie down: for hare-finders (who use to watch them) say they will do thus, though they be not pursued. And thus these actions which are imputed to craft, thereby to confound the Doggs, or to wisdom, to walke themselves untill they be grown into a

fitting temper to sit still ; may all of them be reduced to those materiall and corporeal causes, which make them do their other ordinary motions, wherein we find no difficulty.

13
Of a Fox reported to have weighed a Goose, before he would venture with it over a River ; and of fabulous stories in common.

If that of the Foxes weighing his Goose, before he would venture to carry it over the River, were plainly true, as it is set down ; I avow I should be hard set to find the principles from whence that discretion in him proceeded : but I conceive this tale may be paired with that, which telleth us of an other Fox who having his prey taken from him by an Eagle, brought the next day a new prize in the same place, having first rolled it in the fire, so that some burning coales stuck upon it ; which the Eagle comming againe and snatching from him, carried to her Nest, which was thereby set on fire ; and the young ones falling down, became the Foxes share, instead of what their Dam had robbed him of. Such stories so quaintly contrived, are fitter for a morall then for a naturall Philosopher : Æsop may entertaine himselfe and his disciples with them ; whiles all the reflection I shall make upon them, is, that when I hear any such finely ordered tales, I cannot doubt but they are well amended in the relation, by those that tell them : it being the inclination and custome of most men, (partly through a desire of having strange things come from them ; and partly out of a care that what they say may appeare like truth, and so be the easier believed) to add circumstances beyond the truth of the matter : which increasing at every new mans relation of the same accident (for this humour raigneth very generally) at the length, so handsome, and yet so strange a tale is composed, that the first author or teller of it, wondereth at it, as well as others, and cannot discern that his story begot this latter.

Therefore, when one of these fine tales is proposed to speculate upon, and that I have no light to guide me in determining what part of them to allow, and what to reject ; I think it better to expect an authentique record of it, then be too hasty at guesses : leaving such as pretend ability in reading of Riddles to descant of the wayes how such actions may be affected : but for others, that have a semblance of truth, or do happen ordinarily, be they at the first sight never so like the operations of reason, I doubt not but that the causes of them may be reduced to the

the principles we have already established; and the wayes of performing them, may be pitched upon by such discourtes about them, as we have made about those examples we have above produced. Especially if the actions themselves were observed by one that could judge of them, and were reported with a desire of expressing the truth nakedly as in it selfe it lieth; for divers times it hapneth, that men saying nothing but truth, do expresse it in such manner, and with such terms, that the ignorant hearer conceiveth the thing quite another way, then indeed it is, meerly for the too emphaticall expressions: especially if the relatour himselfe misseth in conceiving the true causes of what he reporteth, and so expresseth it proportionable to those which he apprehendeth.

To conclude then this first branch, we see how the doubting, the resolving, the ayming, the inventing, and the like, which we experience in beasts, may by the vestigiaes we have traced out, be followed unto their root, as far as the division of rarity and density; without needing to repaire unto any higher principle, saving the wisdom of the Orderer and Architect of nature, in so admirably disposing and mingling these material, grosse, and lifelesse bodies, that strange effect and incomprehensible unto them, who will not look into their severall joynts, may follow out of them, for the good of the creature in whose behalfe they are so ordered.

But before we go to the next point, we cannot forbear mentioning their vanity as well as ignorance, who to purchase the estimation of deeper knowers of nature, would have it believed, that beasts have compleat languages, as men have, to discourse with one another in; which they wanted they had the intelligence of. It is true, that in us speaking or talking is an operation of reason; not because it is in reason; but because it is the work of reason, by another instrument; & is no where to be found without reason; which those irrational Phylosophers, that pretended to understand the language of beasts, allowed them as well as the ability of talking to one another: but it was because they had more pride then knowledge. Of which rank one of the chief, was Apollonius, surnamed from Thyana; for if he had known how to looke into the nature of beasts, he would have perceived the reason of the divers voyces which the same beasts in divers occasions formeth.

14
Of the severall
cryings and
tones of beasts;
with a refuta-
tion of those
authors who
maintain them
to have com-
pleat langua-
ges.

This

This is evident, that an animals lungs and chest, lying so neere as they doe unto his heart, and all voice being made by the breathes comming out of his mouth, and through his windpipe, it must necessarily follow, that by the divers orderings of these instruments, his voyce will become divers; and these instruments will be diversly ordered in him, according to the divers motions of his heart: that is, by divers passions in him (for so we may observe in our selves, that our breath is much changed by our being in passion;) and consequently, as a beast is agitated by various passions, he must needs utter variety of voyces, which cannot chuse, but make divers impressions in other beasts, that have commerce with him, whether they be of the same kind as he is, or of a different: and so we see, that if a Dogg setteth upon a Hogg, the bitten Hoggs cry, maketh an impression in the other Hogs, to come to their fellows rescue, and in other Dogs to run after the crying Hog: in like manner, anger in a Dogg maketh snarling or barking, paine, whining, desire, another kind of barking; and his joy of seeing a person that he useth to receive good by, will break out in another kind of whining. So in a Hen her divers passions work divers kinds of clocking; as when shee seeth a Kite, she hath one voyce, when she meeteth with meat, another; when she desireth to gather her chickens under her wing, a third: and so, upon divers occasions, a divers sound; according to the divers ordering of her vocall instruments by the passion which preffeth her heart. So that who would look curiously into the motions of the dispositions of a beasts vocall instruments, and into the motions of the spirits about his heart (which motion we have shewed is passion) would be able to give account, why every voyce of that beast was such a one, and what motion about the heart it were that caused it.

And as much may be observed in men, who in paines and griefes, and other passions, doe use to break out into those voyces, which we call interjections, and which signifie nothing in the understanding of them that forme them, but to the hearer are signes of the passion from whence they proceed: which if a man do heedfully mark in himselfe, he will perceiue that they are nothing else, but the sudain eruptions of a great deale of breath together, caused by some compression made within him, by the
paine.

pain he is in. Which is the reason that the striving against gronings in certain occasions, doth sick persons much harm; for it disordereth the naturall motions of some principal parts within him, that are already too much agitated; and the counter-motion by which they are checked, putteth them further into a more violent agitation. In the observation of these natural eruptions of mens breath, caused by passion, our forefathers of old were so industrious, as to transferre the imitation of nature in this particular into musick, so that their kinds of musick were distinguished according to the division of mens passions; and by similitude would raise them in the hearers.

Out of this discourse also reason may be given, why birds are more musickall then other creatures, to wit, because they are of a hotter complexion; and therefore, to their bignesse, do require more breath and ayr to cool them; and consequently do make more noise, and more variety of it. Likewise, among beasts, dogs are the most vocal of any that converse with us; who by their ready anger appear to be the hottest. Among men, those that are merry, or soon become heated with a little wine, are given to talking or singing: and so are children and women likewise; not so much through abundance of heat as because their heat doth easily vent.

And thus it is evident, that there is no true language among beasts: their voices not being tokens of divers things or conceptions, but meerly the effects of divers breathings, caused by divers passions. Wherefore, since both breathing and passion, are easily reduced to the common principles of rarity and density; we need not trouble our selves any further, to seek into the origine of this vocal faculty of beasts.

THE

THE SEVEN AND THIRTIETH CHAP.

*Of the docility of some irrational animals ; and of
certaine continuate actions of a long tract of time so
orderly performed by them, that they seem to argue know-
ledge in them*

^I
How Hawkes
and other
creatures are
taught to doe
what they are
brought up to.

AS for docility, (which is our second head) Apes and Elephants are most famed, Though peradventure, the cunning and obedience of our Hawkes and Dogs, is no whit inferiour to what is reported of them ; and would be as much admired, were it not so common. I have by sundry persons who have seen him, been told of a Baboon, that would play certain lessons upon a Guittare. The Indian histories make mention of Apes, that will go to the Taverne and fetch Wine for their masters ; as Lipsius his Dog would bring his master as much meat from the Market, as he carried money to his butcher to pay for. Of Elephants likewise, strange things are told: but because we cannot easily judge how to understand reports, wherefore we have not seen the experience, nor how far to believe them, I intend not to insist upon the examining of them; for by looking into the nature and art of our Hounds that follow a suite of blood, or that draw dry foot ; and of our Hawkes, especially of the decoy Ducks and Cormorants ; a scantling may be given at all the rest. And although these things told at random, may justly seem very admirable to any man the first time he heareth of them, yet to him that understandeth how they are taught, there is no one passage but will appeare plaine enough.

The first degree is to tame the Hawke by watching her from sleep, and to acquaint her with the man by continually carrying her upon his fist, and using her to take her meat quietly, as she sitteth upon his hand. Then he maketh her hop a little way to it in a paire of cranes: & after a while, kill a seeled pidgeon; from which he taketh her when she is grown steady in her lesson so far and feedeth her up with other meat : and thus in time he bringeth her to flie at what he will have her, and to be content

with

with a small reward, leaving her quarry to her master ; so that a spectatour, who understandeth not the mystery, nor ever saw hawking before, may wel admire to see a bird so daintily and exactly obey a mans command : and may conceive she hath a reasonable soule, whereby to understand him and discourse of the means to bring his purpose to effect. Whereas indeed all this is no more, then to make her do for you, and when you please, the same which she doth by nature to feed her self.

The cunning of dogs is begotten in the same way. Coyducks are beaten and whipped to what they are taught, like setting dogs. Cormorants have their throats tied, that they may not swallow the fish they catch, but be constrained to bring it to the man that imployeth them ; so that looking along step by step, you shall meet with nothing but what is plain and easie to be taught, and to be performed by sense and memory ; without needing to attribute any discourse or reasoning unto beasts.

Apes are likewise taught as dogs may be, to carry things to a certain house ; where receiving what is given them, they return home with it : and you may be confident, this servicable-nesse of the Ape, grew out of his being carried first to the tavern by the maid or boy, who there gave him something that pleased him ; and then being made to carry the pot along by the boy ; and afterward being made to carry money in one hand, and the pot in the other ? where of some drawer discharged him of the one, and filled the other, and withall gave him a reward ; which also was repeated to him at his return home with his full pot : till at the last, when he was sufficiently used to this exercise, he would of himself go straight thither, as soon as he was harnessed in such sort as he used to be for this service. Which appeareth to be assuefaction and custome, not judgement, by his receiving indifferently whatsoever is put into his pot.

And by the tale of Lipsius his dog ; from whom other lesse dogs, snatching as he trotted along, part of what hung out of his basket (which he carried in his mouth) he set it down to worry one of them ; whiles in the mean time, the others fed at liberty, and at ease upon the meat that lay there unguarded, til he coming back to it, drove them away, and himself made an end
of

of eating it up. Whereby we may conceive that the species of carrying his basket to his master (which custome had settled in his memory) was disordered, and thrust out of his fantasie, by a stronger, of fighting for his meat with the other cures: after which it followed naturally in his fantasie, to eat what he had fought for. And that sending then spirits into his nerves, agreeable to the nature of it, and governing the parts depending of the brain, a motion and action ensued, which was futable to the object in the fantasie; and this could be none other, but of eating what the fantasie found conformable unto its nature.

²
Of the Baboon that played on a guittarre.

The baboon we have mentioned, might be taught some lessons made on purpose with very few stops, and upon an instrument whereon all the strings may be stricken with one blow, and but one fret to be used at a time, and that fret to be stopped with one finger: of which much labour and time might beget a habit in him: and then, imitation of the sound, might make him play in due measure. And if we will mark it in our selves, we shall see, that although in the first learning of a lesson upon the Lute, we imploy our reason and discourse about it; yet when we have it very perfect, our fingers (guided by a slight fantasie) do fall by custome, without any reflexion at all, to play it as well as if we thought never so carefully upon it. And there is no comparison, between the difficulty of a guittarre and of a lute.

I have been told that at the Duke of Florence his marriage, there was a dance of horses, in which they kept exact time of musick. The means used for bringing them to it, is said to have been by tying and hampering their legs in such sort, that they could lift them up but in a determinate way: and then setting them upon the pavement, that was heated underneath so hot that they could not endure to stand still, whiles such musickall ayres were played to them, as fitted their motions. All which being often repeated, the horses took a habit, that in hearing those ayres; they would lift up their legs in that fashion; and so danced to the the tune they had been taught.

³
Of the teaching of Elephants & other beasts to do divers tricks.

Of the Elephants, it is said that they may be taught to write; and that purely upon words, and commanding them, they will do what they are bidden; and that they are able to keep account,

count, and will leave working at a precise number of revolutions of the same action, which measureth out their task unto them. All which (as I said before) if it were plainly and literally true, would require very great consideration: but because the teachers of beasts have certain secrets in their art, which standers by do not reach unto; we are not able (upon such scanty relations as we have of them) to make sufficient judgement how such things are done; unlesse we had the managing of those creatures, whereby to try them in several occasions, and to observe what cause produceth every operation they do; and by what steps they attaine unto their instructions and serviceablenesse.

It is true, the uncontrolled reports of them oblige us to believe some extraordinary matter of their docility, and of strange things done by them: but withall, the example of other taught beasts among us; and of the strange judgements that are made of them by persons, who do not penetrate into their causes, may instruct us, how easie it is to mistake the matter; and assure us, that the relations which are made unto us, do not alwaies punctually agree with the truth of what passed. He that should tell an Indian what feats Bankes his horse would do, how he would restore a glove to the due owner, after his master had whispered that mans name in his eare; how he would tell the just number of pence in any piece of silver coyne barely shewed him by his master; and even obey presently his command, in discharging himselfe of his excrements whensoever he bad him (so great a power art may have over nature:) would make him believe, admire more at this learned beast, then we doe at their docile Elephants, upon the relations we have of them. Whereas every one of us knoweth; by what meanes his painfull tutor brought him to doe all his tricks: and they are no whit more extraordinary, then a fawkners manning of a hawk, and training her up to kill Partridges, and to flie at the retrieve: but doe all of them (both these, and all other jugling artifices of beasts) depend upon the same, or like principles; and are known to be but directions of nature, ordered by one that composeth and levelleth her operations to another end further off (in those actions) then she of her selfe would aime at. The particulars of which, we need not trouble our selves to meddle with.

But

4
Of the orderly
train of actions
performed
by beasts in
breeding their
young ones.

But it is time that we come to the third sort of actions performed by beasts, which we promised to discourse of. These seem to be more admirable, then any we have yet touched : and are chiefly concerning the breeding of their young ones. Above all others, the orderly course of birds in this affaire, is most remarkable. After they have coupled they make their nest, they line it with moss, straw, and feathers ; they lay their egges, they sit upon them, they hatch them, they feed their young ones, and they teach them to flie : all which they doe with so continueate and regular a method, as no man can direct or imagine a better.

But as for the regularity, orderliness, and continuance of these actions, the matter is easie enough to be conceived : for seeing that the operation of the male, maketh a change in the female ; and that this change beginning from the very first, groweth by time into divers proportions : it is no wonder that it breedeth divers dispositions in the female, which cause her to doe different actions, correspondent to those divers dispositions. Now, those actions must of necessity be constant and orderly, because the causes whence they proceed, are such.

But to determine in particular how it commeth to passe, that every change in the female disposeth her to such and such actions, there is the difficulty ; and it is no small one : as well, for that there are no carefull and due observations, made of the effect and circumstances which should guide us to judge of their causes ; as because these actions are the most refined ones of sensitive creatures ; and doe flow from the top and perfection of their nature ; and are the last straine of their utmost vigour, unto which all others are subordinate. As in our enquiry into the motions and operations of the bodies of a lower orbe then these, we meet with some (namely the loadstone, and such like) of which it is very hard to give exact and plaine account ; the Author of them reserving something from our cleare and distinct knowledge ; and suffering us to looke upon it but through a mist : in like manner we cannot but expect, that in the depth of this other perfect nature, there must be somewhat, whereof we can have but a glimmering and imperfect notion. But as in the other, it served our turne to trace out a way, how those operations might be effected by bodies, and by local motion

motion (though peradventure, we did not in every circumstance hit exactly upon the right) thereby to defend our selves from admitting those chymericall qualities, which we had already condemned, upon all other occasions.

So I conceive, it will be sufficient for us in this, to shew how these actions may be done by the senses, and by the motion of corporeal spirits and by material impressions upon them; without being constrained to resort unto an immaterial principle, which must furnish Birds with reason and discourse: in which, it is not necessary for my purpose, to determine precisely every step by which these actions are performed, and to settle the rigorous truth of them: but leaving that unto those, who shall take pains to deliver the history of their nature, I will content my selfe with the possibility and probability of my conjectures. The first of which qualities, I am obliged to make plain; but the latter concerneth this Treatise no more, then it would do a man to enquire anxiously into the particulars of what it is that a beast is doing, while looking upon it at a great distance, he perceiveth plainly that it moveth it selfe: and his arrant is, but to be assured whether it be alive or dead: which the moving of it selfe in common, doth sufficiently demonstrate, without descending into a particular search, of what his motions are.

But let us come to the matter: first I conceive no man will make any difficulty in allowing that it is the temper of the blood and spirits in Birds (brought thereunto by the quality of their food, and by the season of the year) which maketh them couple with one another, and not any ayme or desire of having young ones, that occasioneth this action in them. Then it followeth that the Hens egges will encrease in her belly; and when they grow big, they cannot choose but be troublesome unto her; and therefore must of necessity breed in her an inclination to rest in some soft place, and to be rid of them. And as we see a Dog or a Cat pressed by nature, searcheth about to find a convenient place to disburden themselves in, not onely of their young ones, but even of their excrements; so do Birds, whose egges within them, making them heavy and unfit to flie, they begin to sit much, and are pleased in a soft and warme place: and thereupon they are delighted with straws and mosse, and other gentle substances;

stances; and so carry them to their sitting place: which that they do not by designe, is evident by the manner of it; for when they have met with a straw or other fit material, they flie not with it directly to their nest, but first to a bough of some tree, or to the top of a house; and there they hop and dance a while with it in their beakes; and from thence skip to another place, where they entertain themselves in like manner: and at the last, they get to their nest: where if the straw should lie confusedly, their ends would prick and hurt them: and therefore they turn and alter their positions till they lie smooth: which we that look upon the effect, and compare them with our performing of like actions (if we had occasion) may call a judicious ordering of them, whereas in them, it is nothing but removing such things as presse upon their sense, untill they cause them no more paine or unquietnesse.

Their plaistering of their nests, may be attributed to the great heat raiging in them at that time; which maketh them still be dabbling in moist clay, and in water, and in gravell, (without which, all Birds will soon grow sick, blind, and at length die) which (for the coolnesse of it) they bring home to their nests in their beakes and upon their feet; and when it groweth dry, and consequently troublesome to them, they wipe it off, and rub their dirty parts upon the place where they use to sit; and then flie for more to refresh themselves withall.

Out of all which actions (set on foot by the wise orderer of nature, to compasse a remote end, quite different from the immediate end that every one of them is done for) there resulteth a fit and convenient place for these little builders (that know not what they do, whiles they build themselves houses) to lie in, and to lay their egges in. Which the next year, when the like occasion occurreth, they build again; peradventure then, as much through memory of the former, as upon their temper and other circumstances moving their fantasie, in such sort as we have set downe.

In like manner, that whiles the Halcyon layeth and hatcheth her egges, the Sea is calme, needeth no more be attributed to the wisdom and providence of that Bird, in choosing a fit season then to any good nature or discourse in that rouling and merci
left

lesse Element ; as though it had a pious care of preserving the egges committed to his trust : no such supplements are requisite to be added to the distributions of nature, who hath set material causes on foot, to produce a conjecture of both those effects at the same period of time, for the propagation of this animals species.

In fine, both the time and place of the Halcyons breeding, and the manner and order, and reason of all Birds making their nests, proceedeth from secret motions, which do require great observing and attention to understand them ; and do serve for directions unto every Bird, according to her kind, to make her nest fittest for her use. Which secret motions, we cannot doubt but are material ones, and do arise out of the constitution and temper of their bodies and spirits ; which in like circumstances are alike in them all : for all the Birds of one kind do make their nests exactly alike ; which they would not do, if this work proceeded from reason in them, and were governed by their own election and designe : as we see it happen among men upon all occasions, either of building houses, or of making cloaths, or of what action soever is guided by their reason governing their fantastic ; in all which we see so great variety and inconstancy.

And therefore this invariability in the Birds operations, must proceed from a higher intellect, that hath determinately and precisely ordered a complexe or assembly of sundry causes, to meet intallibly and by necessity, for the production of an effect that he hath designed : and so, the Birds are but material instruments to performe without their knowledge or reflexion, a superiour reasons, counsels : even as in a clock, that is composed of several pieces and wheelles, all the parts of it do conspire to give notice of the several effluxes and periods of time, which the maker hath ordered it for.

And although this be a work of reason and discourse in him, that did set it together ; yet the instrumentall performance of it, dependeth meerly of locall motion, and of the revolutions of bodies, so orderly proportioned to one another, that their effects cannot faile ; when once the engine is wound up : in like manner then the Bird is the engine of the Artificer, infinitely more perfect, and knowing, and dexterious then a poore clock-maker ;

maker ; and the plummets which do make it go, are the row and order of causes chained together, which by the designe of the supreme work-man, do bring to passe such effects, as we see in the building of their nests, and in doing such other actions, as may be compared to the strikings of the clock, and the ringing of the alarme at due times.

And as that King of China, upon his first seeing a Watch, thought it a living and judicious creature, because it moved so regularly of it selfe, and believed it to be dead when it was run out; till the opening of it, and the winding it up, discovered unto him the artifice of it : so any man may be excused, that looking upon these strange actions, and this admirable oeconomy of some living creatures, should believe them endued with reason, untill he have well reflected upon every particular circumstance of their nature and operations : for then he will discern how these are but material instruments of a rational agent working by them, from whose orderly prescriptions, they have not power to swarve in the least circumstance that is. Every one of which considered singly by it self, hath a face of no more difficulty, then that (for example) an engineer should so order his matters, that a mine should be ready to play exactly at such an hour, by leaving such a proportion of kindled match hanging out of one of the barrels of powder, whiles in the mean time, he either sleepeth, or attendeth to something else.

And when you have once gained thus much of your selfe, to agree unto an orderly course and generation of any single effect, by the power of a material cause working it ; raise but your discourse a strain higher, and look with reverence and duty upon the immensity of that provident Architect, out of whose hands these Master-pieces issue, and unto whom it is as easie to make a chain of causes of a thousand, or of a million of links, as to make one link alone : and then you will no longer stick at allowing the whole oeconomy of those actions, to be nothing else, but a production of material effects, by a due ranging and ordering of material causes.

But let us return to our theme : as we see that milk coming into the breasts of live-bearing female creatures, when they grow very big, heateth and maketh them seek the mouths

mouths of their young ones, to disburthen and coole them : so the carriage and bignesse of the egges, heateth exceedingly the breasts and bodies of the birds ; and this causeth them to be still rubbing of their breasts against the sides of their nests (whereunto their unwieldinesse then confineth them very much) and with their beakes to be still picking their feathers ; which being then apt to fall off and men (as we see the haire of women with child, is apt to shed) it happeneth that by then they are ready to lay their egges, they have a soft bed of their own feathers, made in their nests, over their courser mat-
trasse of strawes they first brought thither : and then, the egges powerfull attracting of the anoying heat from the hens breasts (whose imbibing of the warmth, and stone-like shell, cannot choose but coole her much) inviteth her to sit constantly upon them, untill sitting hatcheth them ; and it is evident, that this sitting must proceed from their temper at that time, or from some other immediate cause, which worketh that effect, and not from a judgement that doth it for a remote end : for housewives tell us, that at such a season, their hens will be sitting in every convenient place they come unto, as though they had eggs to hatch, when never a one is under them : so as it seemeth that at such time, there is some inconvenience in their bodies, which by sitting is eased.

When the chickens are hatched, what wonder is it, if the litle crying of tender creatures, of a like nature and language with their dammes, do move those affections or passions in her bosome, which causeth her to feed them, and to defend, and breed them, till they be able to shift for themselves ? For all this, their needeth no discourse or reason ; but onely the motion of the blood about the heart (which we have determined to be passion) stirred by the young ones chirpings, in such sort, as may carry them unto those actions which by nature (the supreme intellect) are ordered for their preservation. Wherein the birds (as we have already said) are but passive instruments, and know not why they do those actions : but do them they must, whensoever such and such objects (which infallibly work in their due times) do make such and such impressions upon their fantasies, like the allarm that necessarily striketh, when

the hand of the dial commeth to such a point; or the gun-powder, that necessarily maketh a ruine and breach in the wall, when the burning of the match reacheth to it.

Now this love in the dam, growing by little and little wearisome and troublesome to her; and at last, fading quite away; and she not being able to supply their encreased needs, which they grow every day stronger to provide for of themselves; the strait commerce beginneth to dye on both sides: and by these degrees the dam leaveth her young ones to their own conduct.

And thus you see how this long *series* of actions, may have orderly causes, made and chained together, by him that knew what was fitting for the work he went about. Of which though it is likely I have missed of the right ones (as it cannot choose but happen in all disquisitions, where one is the first to breake the Ice, and is so slenderly informed of the particular circumstances of the matter in question, as I professe to be in this) yet I conceive this discourse doth plainly shew, that he who hath done more then we are able to comprehend and understand, may have set causes sufficient for all these effects, in a better order and in compleater ranks, then those which we have here expressed: and yet in them so coarsely hewed out, appeareth a possibility of having the work done by corporeal agents. Surely it were very well worth the while, for some curious and judicious person, to observe carefully and often, the several steps of nature in this progresse: for I am strongly perswaded, that by such industry, we might in time arrive to very particular knowledge of the immediate and precise causes, that work all these effects. And I conceive, that such observation needeth not be very troublesome; as not requiring any great variety of creatures to institute it upon; for by marking carefully all that passeth among our homebred hens, I believe it were easie to guess very nearely at all the rest.

THE EIGHT AND THIRTIETH CHAPTER.

*Of prescience of future events, providences, the knowing of things
never seen before; and such other actions, observed in
some living creatures; which seem to be even
above the reason that is in
man himselfe.*

THE fourth and last kind of actions, which we may with astonishment observe among beasts, I conceive will avails little to infer out of them, that the creatures which do them, are endued with reason and understanding: for such they are, as if we should admit that, yet we should still be as far to seek for the causes whence they proceed. What should move a lamb to tremble at the first sight of a Wolfe? or a hen at a kite never before seen? neither the grimmest Mastiffe, or the biggest owle, will at all affright them.

That which in the ordinary course of nature, causeth beasts to be afraid of men, or of other beasts, is the hurt and the evil they receive from them: which comming into their fantasie, together with the Idea of him that did it, is also lodged together with it in the memory; from whence they come linked or glewed together, whensoever the stroake of any new object calleth either of them back into the fantasie. This is confirmed by the tameness of the birds and beasts, which the first discoverers of Islands not inhabited by men, did finde in those they met withall there. Their stories tell us, that at their first arrivall upon those coasts, where it seemeth men had never been, the birds would not flie away, but suffered the mariners to take them in their hands: nor the beasts, which with us are wild, would run from them; but their discourteous guests used them so hardly, as they soon changed their confidence into distrust and aversion; and by little they grew, by their commerce with men, and by receiving injuries from them, to be as wild, as any of the like kind in our parts.

From the dammes and fires, this apprehension and fear at

Why beasts
are afraid of
men.

the sight of men, so deeply rooted in them, is doubtlesly transmitted to their young ones ; for it proceedeth out of the disposition of the body, & out of the passion which is immediately made in the heart ; and that is as truly a materiall motion, as any whatsoever can be ; and must have seited materiall instruments fitted to it, if it be constant, as well as any other natural operation whatsoever : and this passion of the heart proceedeth again from a perpetuall connexion of the two objects in the memory : which being a perpetuall constant thing, is as true a quality of that beasts brain in whom it is, as the being of a quick or dull apprehension, or the being apt to know one kind of meat from another (which is naturall to the whole species) or any other quality whatsoever, residing in that beast.

How some
qualities cau-
sed at first by
change in
beasts, may
passe by gene-
ration to the
whole off-
spring.

Wherefore it is no wonder, that it passeth by generation to the off-spring : which is a thing so common, even in mankind as there can be no doubt of it : and is at the first made by a violent cause, that greatly altereth the body : and consequently their seed must be imbrewed with a like disposition ; and so it passeth together with the nature of the sire, or of the dam, into the brood. From hence proceedeth, that children do love the same meats, and exercises, that their fathers and mothers were affected with, and feare the like harmes.

This is the reason, why a grand-child of my Lord of Dorset (whose honoured name must never be mentioned by me without a particular respect, and humble acknowledgement of the noble & steady friendship, he hath ever been pleased to honour me with) was alwayes extreemly sick, if but the Nurse did eat any Capers (against which my Lords antipathy is famous) whiles she gave suck to that pretty infant. The Children of great Mathematicians, who have been used to busie their fantasies continually with figures and proportions, have been oftentimes observed, to have a naturall bent unto those Sciences. And we may note that even in particular gestures, and in little singularities in familiar conversation, children will oftentimes resemble their parents, as well as in the lineaments of their faces. The young ones of excellent setting dogges, will have a notable aptitude to that exercise ; and may be taught with
halfe

halfe the paines, that their sire or dam was; if they were chosen out of a race of spaniels not trained to setting. All which effects can proceed from no other cause, but (as we have touched already) that the fantasie of the parent, altereth the temper and the disposition of his body and seed, according as it self is tempered and disposed: and consequently, such a creature must be made of it, as retaineth the same qualities: in such sort as it is said that sufficient tartar put at the root of a tree, will make the fruit have a winy tast.

But nothing doth confirme this so much, as certain notable accidents, whereof though every one in particular would seem incredible, yet the number of them, and the weight of the reporters, who are the witnesses, canot choose but purchase a generall credit to the kind of them. These accidents are, that out of some strong imagination of the parents, but especially of the mother, in the time of conception, the children draw such main differences, as were incredible, if the testifying authority were not so great: but being true, they convince beyond all question the truth we have proposed, of the parents imagination working upon, and making an impression in the seed, whereof children or young ones of their kind are made. Some children of white parents are reported to have been black upon occasion of a black moores picture too much in the mothers eye. Others are said to have been born with their skins all hairy, out of the sight of St. *John Baptists* picture as he was in the desert, or of some other hairy image. Another child is famed to have been born deformed, in such sort as Devils are painted, because the father was in the Devils habit when he got the child.

How the parents fantasie doth oftentimes worke strange effects in their issue:

There was a Lady a kinswoman of mine, who used much to weare black patches upon her face (as was the fashion among young women) which I to put her from, used to tell her in jest that the next child she should go with, whiles the sollicitude and care of those patches was so strong in her fantasie, would come into the world with a great black spot in the midst of its fore-head: and this apprehension was so lively in her imagination at the time she proved with child, that her daughter was born marked just as the mother had fantasied, which there

there are at hand witnesses enough to confirme; but none more pregnant, then the young Lady her self, upon whom the mark is yet remaining. Among other creatures, it is said that a hen hatched a chicken with a Kites bill, because she was frightened with a Kite while the Cock was treading her. The story of *Jacobs* sheep is known to all: and some do write, that the painting of beautifull coloured pigeons in a dove-house, will make the following race become like them: and in Authors store of such examples may be found.

To give a reasonable and fully satisfying cause of this great effect, I confesse is very difficult; seeing that for the most part, the parents seed is made long time before the accomplishing of the male and female: and though it were not, we should be mainly to seek for a rational ground to discourse in particular upon it. Yet not to leave our Reader without a hint which way to drive his inquisition, we will note thus much, that Aristotle and other naturall Philosophers and Physitians do affirme, that in some persons the passion is so great in the time of their accomplishing, that for the present it quite bereaveh them of the use of reason; and that they are for the while in a kind of short fit of an epilepsie. By which it is manifest, that abundance of animal spirits do then part from the head, and descend into those parts which are the instruments of generation. Wherefore, if there be abundance of specieses of any one kind of object then strong in the imagination, it must of necessity be carried down together with the spirits in to the seed: and by consequence, when the seed infected with this nature, beginneth to seporate & distribute it self, to the forming of the severall parts of the Embryon, the spirits which do resort into the brain of the child (as to their proper Element) and from thence do finish all the outward cast of its body (in such sort as we have above described) do sometimes happen to fill certaine places of the childes body, with the infection and tincture of this object; and that according to the impression with which they were in the mothers fantasie: for so we have said, that things which come together into the fantasie, do naturally sticke together in the animal spirits. The hairinesse therefore will be occasioned in those parts, where the mother fantasied it to be:

be : the colour likewise, and such extancies or defects, as may any way proceed from such a cause, will happen to be in those parts, in which they were fancied. And this is as farre as is fit to wade into this point; for so generall a discourse as ours is; and more then was necessary for our turne: to the serving whereof, the verity of the fact onely, and not the knowledge of the cause, was required: for we were to shew no more, but that the apprehensions of the parents, may descend to the children.

Out of this discourse, the reason appeareth, why beasts have an aversion from those who use do them harme: and why this aversion descendeth from the old ones to their brood; though it should never have happened that they had formerly encountered with, what at the first sight they flye from and avoid.

But yet the reason appeareth not, why (for example) a sheep in England (where there are no wolves breed; nor have been these many ages) should be afraid; and tremble at sight of a Wolfe, since neither he, nor his damme or sire, nor theirs in multitudes of generations, ever saw a wolfe, or received hurt by any. In like manner, how should a tame weasel brought into England from Ireland (where there are no poysonous creatures) be afraid of a toad as soon as he seeth one? Neither he nor any of his race, ever had any impressions following harme, made upon their fantasies: and as little can a Lyon receive hurt from a household Cock: therefore we must seek the reasons of these and such like antipathies a little further and we shall finde them hanging upon the same string, with sympathies proportionable to them.

Of Antipathies.

Let us go by degrees: we daily see that dogges will have an aversion from Glovers, that make their ware of dogs skins: they will barke at them, and be churlish to them, and not endure to come neer them, although they never saw them before. The like hatred they will expresse to the dog killers in the time of the plague, and to those that flea dogs. I have known of a man that used to be imployed in such affaires, who passing sometimes over the grounds neer my mothers house (for he dwelled at a village not farre off) the dogs would.

would wind him at a very great distance, and would all runne furiously out the way he was, and fiercely fall upon him; which made him go alwayes well provided for them: and yet he hath been sometimes hard put to it, by the fierce Mastifes there, had it not been for some of the servants coming in to his rescue; who by the frequent happening of such accidents were warned to look out when they observed so great commotion and fury in the dogges, and yet perceived no present cause for it. Warreners observe, that vermin will hardly come into a trap wherein another of their kind hath been lately killed: and the like happeneth in Mouse-traps, into which no Mouse will come to take the baite, if a Mouse or two have already been killed in it; unlesse it be made very cleane, so that no scent of them remain upon the trap: which can hardly be done on the sudden otherwise then by fire.

It is evident, that these effects are to be referred to an activity of the object upon the sense; for some smell of the skinnes, or of the dead dogges, or of the vermine, or of the Mice, cannot choose but remain upon the men and upon the traps; which being altered from their due nature and temper: must needs offend them. Their conformity on the one side (for something of the canine nature remaineth) maketh them have easie ingression into them; and so they presently make a deep impression: but on the other side, their distemper from what they should be, maketh the impression repugnant to their nature, and be disliked by them, and to affect them worse, then if they were of other creatures, that had no conformity with them: as we may observe, that stinkes offend us more, when they are accompanied with some weak perfume, then if they set upon us single; for the perfume getteth the stinke easie admittance into our sense: and in like manner, it is said that poysons are more dangerous, when they are mingled with a cordiall that is not able to resist them: for it serveth to convey them to the heart, though it be not able to overcome their malignitie.

From hence then it followeth, that if any beast or bird do prey upon some of another kind, their will be some smell about them; exceedingly noysome to all others of that kind; and

and not onely to Beasts of that same kinde ; but (for the same reason) even to others likewise, that have a correspondence and agreement of temper and constitution with that kinde of Beast, whose hurt is the original cause of this aversion- Which being assented unto, the same reason holdeth to make those creatures, whose constitutions and tempers do consist of things repugnant and odious to one another, be at perpetual enmity, and flye from one another at the first sight, or at the least, the sufferer from the more active creature : as we see among those men, whose unhappy trade and continuall exercises it is to empty jakeses, such horrid stinkes are by time grown so conformable to their nature, as a strong perfume will as much offend them, and make them as sick, as such stinkes would do another man bred up among perfumes : and a cordial to their spirits, is some noysome smell, that would almost poyson another man. And thus, if in the breath of the Wolfe, or in the steame comming from his body, be any quality offensive to the Lamb (as it may very well be, where there is so great a contrariety of natures) it is not strange, that at the first sight and approach of him, he should be distempered and flye from him ; as one Fighting Cock will do from another, that hath eaten Garlick : and the same happeneth between the Weasel and the Toad, the Lyon and the Cock, the Toad and the Spider, and severall other creatures, of whom like enmities are reported.

All which are caused in them, not by secret instincts, and antipathies, and sympathies, wherof we can give no account, (with the bare sound of which words, most men do pay themselves, without examining what they mean ;) but by downright material qualities, that are of contrary natures (as Fire and water are) and are either begotten in them in their original constitution, or are implanted in them afterwards by their continual food, which nourishing them, changeth their constitution to its complexion. And I am perswaded this would go so far, that if one man were nourished continually with such meat (and greedily affected with it) which another had aversion from, there would naturally follow much dislike between them ; unlesse some superiour regard should master

will

this

this averſion of the ſenſe. And I remember to have ſeen two notable examples of it: the one in Spain, of a Gentleman that had a horror to Garlick, who (though he was very ſubject to the impreſſions of beauty) could never weane himſelfe from an averſion, he had ſetled him to a very handſome woman, that uſed to eat much Garlick, though to win him, ſhe forbore the uſe of that meat, which to her was the moſt ſavoury of all others. And the like I knew in England between two, whereof the one did extreemly love cheeſe, and the other as much hated it, and would fall into a ſtrange agony, and be reduced (one would think) to the point of death, if by inadvertence or others tryall of him, he had ſwallowed never ſo little, of what the other would have quitted all meates elſe to live upon.

And not onely ſuch averſions, as ſpring from differences of complexions in the conſtitutions of ſeveral animals, do cauſe theſe effects of feare, and of trembling, and of flying from thoſe that do make ſuch impreſſions; but even the ſeeing them angry and in fury doth the lik: for ſuch paſſions do alter the ſpirits; and they iſſuing from the body of the animal in paſſion, cannot chooſe but be received by another in a different manner, then if they were of another temper. Then if the one kind be agreeable to their nature; the other muſt needs be diſpleaſing. And this may be the reaſon why Bees never ſting ſuch as are of a mild and gentle diſpoſition; & will never agree with others, that are of a froward and angry nature. And the ſame one may obſerve among Dogs: and peradventure, a mans fantaſie may be raiſed to ſuch a height of fury, that the fierceſt Beaſts may be afraid to look upon him; and cannot endure that thoſe maſtering ſpirits, which ſtreame out of the Mans eyes, ſhould come into his; ſo much they diſtemper his fantaſie: and therefore he will turne away from the man and avoid him. Which diſcourſe may be confirmed by ſundry examples of Lyons, and Beares, that have run from angry and confident Men, and the like. Since then that a Man that is in his natural hew giveth no diſtaſt, doth ſo much affright fierceſt Beaſts, when he putteth his threatening lookes, it is no wonder, that Beaſts of a milder and ſofter nature, ſhould have feare of him

him settled in them, when they never saw him otherwise then angry, and working mischief to them. And since their brood do receive from their parents, a nature easily moved unto feare or anger, by the sight of what moved them, it is not strange, that at the first sight they should tremble or swell, according as the inward motion of the spirits affordeth.

Now if this hath rendered the Birds in the wilde Islands afraid of Men, who otherwise would be indifferent to them, it is no marvaile to see more violent effects in the Lambes aversion from the Wolfe, or in the Larkes from the Hobbey; since they peradventure have over and above the hurt they use to do them, a deformity in their constitutions: and therefore, though a Lark will flie as well from a Man as from a Hobbey, yet because there is one cause more for his dislike against the Hobbey, then against the Man (namely the deformity of their constitutions) he will flie into the Mans hand, to avoid the Hawkes talons.

Unto some of these causes all antipathies may be reduced: and the like reason may be given for the sympathies we see between some creatures. ⁵ Or sym-
 The little corporeities which issue from the one, have such a conformity with the temper of the other, that it is thereby moved to joyn it selfe unto the body from whence they flow, and affecteth union with it in that way, as it receiveth the impression. If the smell do please it, the Beast will alwayes be smelling at it: if the tast, nothing shall hinder it from feeding upon it when it can reach it. The Fisher-men upon the bank over against New-found-Land, do report that there flocketh about them a kinde of Bird, so greedy of the Fishes livers which they take there, as that to come at them and feed upon them, they will suffer the Men to take them in their hands; and will not flie away, as long as any of their desired meat is in their eye: whence the French men that fish there, do call them *Happe foyes*. The like power a certaine Worme hath with Nightingales.

And thus you see, how they are strong impressions upon sense, and not any discourse of reason, that do govern beasts in their actions: for if their avoiding Men, did proceed from any sagacity in their nature: surely they would exercise it, when they
 see

see that for a bit of meat they incur their destruction : and yet neither the example of their fellowes killed before their eyes in the same pursuit, nor the blowes which themselves do feel ; can serve them for warning, where the sense is so strongly affected : but as soon as the blow that removed them is passed, (if it misse killing or laming them) and they be gotten on wing again, they will returne to their prey as eagerly and as confidently, as if nothing were there to hinder them.

6
That the antipathy of beasts towards one another, may be taken away by assuefaction.

This then being the true reason of all sympathy and antipathy, we cannot admit that any beasts should love or hate one another, for any other cause, then some of those we have touched. All which are reduced to local motion, and to material application of bodies of one nature, to bodies of another ; and are as well transmitted to their young ones, as begotten in themselves : and as the satisfying of their sense, is more prevalent in the *Happe foyes*, then the feare which from other grounds is begotten in their fantasie ; and so maketh them approach to what the other would drive them from.

In like manner, any aversion of the fantasie may be mastered not onely by a more powerfull agent upon the present sense, but also by assuefaction, and by bringing into the fantasie with pleasing circumstances that object which before was displeasing and affrightfull to it : as we see that all sorts of Beasts or Birds, if they be taken young may be tamed and will live quietly together. Doggs that are used to hunt and kill Deer, will live friendly with one that is bred with them ; and that Fawn which otherwise would have bin affraid of them, by such education, groweth confident and playeth boldly with them. Of which we can no longer remain in doubt, if we will believe the story of a Tyger (accounted the cruellest Beast of all others) who being shut up with a Deer, that had bin bred with him from a Kid, and from his being a whelp ; and no meate given him, used meanes to break Prison, when he was half starved, rather then he would hurt his familiar friend. You will not suspect, that it was a moral consideration, which made him so kinde : but the Deer had never come into his fantasie

taſie accompanied with other circumſtances, then of play or of warmth : and therefore hunger (which calleth onely the ſpecies of meat out of the memory into the fantaſie) would never bring the Deere thither, for remedy of that paſſion.

And that which often happeneth to thoſe men, in whom the fantaſie onely worketh, is not much unlike to this : among whom I have ſeen ſome freneticke perſons, that if they be perſwaded they are tyed, and cannot ſtirre from the place where they are ; the will lye ſtill, and make great complaints for their imprifonment ; and not go a ſtep, to reach any meat or drink, that ſhould lye in ſight neare them, although they were never ſo much preſſed with hunger or with thirſt. The reaſon is evident, for the apprehenſion of being tied, is ſo ſtrong in their fantaſie, that their fantaſie can ſend no ſpirits into other parts of their body, whereby to cauſe motion.

And thus the Deere was beholding to the Tigars fantaſy, not to his diſcourſe of morall honeſty, for his life. The like of this Tigar and Deere, is to be ſeen every day in the tower of London ; where a little dog, that was bred with a Lyon from his birth, is ſo familiar and bold with them, that they not onely ſleep together, but ſometimes the dog will be angry with him, and will bite him ; which the Lyon never reſſenteth from him, though any other dog that is put to him, he preſently teareth in pieces.

And thus we plainly ſee, how it cometh about, that beaſts may have ſtrange averſions from things, which are of annoying or deſtructive nature to them, even at the firſt ſight of them : and again, may have great likings of other things, in a manner contrary to their nature, without needing to allow them reaſon, whereby to diſcourſe and judge what is hurtfull to them, or to inſtruct the Tigar we have ſpoken of, or Androduſ his Lyon, the duties of friendſhip and of gratitude.

The longing markes which are often times ſeen in children, and do remaine with them all their life, ſeem to be an off-ſpring of the ſame root or cauſe : but in truth, they proceed from another, although of kinne to this : for the operation of the ſeed is paſſed, when theſe longing markes are imprinted ;

7
Of longing
markes ſeen
in children.

the child being then already formed and quickned ; and they seem to be made suddenly, as by the print of a seale. Therefore to render the cause of them, let us consider another sympathy which is more plain & common. We see that the laughing of one man, will set another on laughing that seeth him laugh, though he know not the cause why the first man laugheth: and the like we see in yawning and stretching, which breedeth the like effect in the looker on. I have heard of a man, that seeing a roasted pigge, after our English fashion with the mouth gaping, could not shut his own mouth as long as he looked upon the pigges : and of another that when he saw any man make a certaine motion with his hand, could not choose but he must make the same : so that being a tyler by his trade, & having one hand imployed with holding his tooles, whiles he held himself with the other upon the eaves of the house he was mending, a man standing below on the ground, made that sign or motion to him ; whereupon he quitted his hold fast to imitate that motion, and fell down, in danger of breaking his necke.

All these effects, do proceed out of the action of the seen object upon the fantasie of the looker on : which making the picture or likenesse of its own action in the others fantasie, maketh his spirits run to the same parts ; and consequently, move the same members, that is do the same actions. And hence it is, that when we heare one speak with love and tender- nesse of an absent person, we are also inclined to love that person, though we never saw him, nor heard of him before : and that whatsoever a good Oratour delivereth well, (that is, with a semblance of passion agreeable to his words) raiseth of its own nature, like affection in the hearers : and that generally men learn and imitate (without designe) the customes and manners of the company they much haunt.

To apply this to our intent, it is easie to conceive, that although the child be in the mothers wombe, can neither see nor heare what the mother doth, never the lesse their cannot passe any great or violent motion in the mothers body, whereof some effect doth not reach unto the child, which is then, one continueate piece with her : and the proper effect of motion on

of trembling in one body, being to produce a like motion or a trembling in another, (as we see in that ordinary example of tuned strings, whereof the one is moved at the striking of the other, by reason of the stroak given to the ayr, which finding a moveable easily moved with a motion of the same tenour, communicateth motion unto it) it followeth that the fantasie of the child, being as it were well tuned to the fantasie of the mother, and the mothers fantasie making a speciall and a very quick motion in her own whole body, (as we see that sudden passions do) this motion or trembling of the mother must needs cause the like motion and trembling in the child, even to the very swiftnesse of the mothers motion. Now as we see when one blusheth, the blood cometh into his face, so the blood runneth in the mother to a certaine place, where she is stricken by the thing longed for: and the like happening to the child, the violence of that sudden motion, dyeth the mark or print of the thing in the tender skin of it: the blood in some measure piercing the skin, and not returning wholly into its naturall course: which effect is not permanent in the mother, because her skin being harder, doth not receive the blood into it, but sendeth it back again, without receiving a tincture from it.

Farre more easie is it, to discover the secret cause of many antipathies or sympathies, which are seen in children, and endure with them the greatest part, if not the whole terme of their life, without any apparent ground for them: as some do not love cheefe, others garlike, others ducks, others divers other kindes of meat, which their parents loved well; and yet in token that this aversion is naturall unto them, and not arising from some d like accidentally taken & imprinted in their fantasie, they will be much harmed if they chance to eate any such meat; though by the much disguising it, they neither know, nor so much as suspect they have done so. The story of the Lady *Hennage* (who was of the bed-chamber to the late Queene *Elizabeth*) that had her cheek blistered by laying a rose upon it whiles she was a sleep, to try if her antipathy against that flower, were so great as she used to pretend, is famous in the Court of England. A Kinsman of mine, whiles

8
Why divers
men hate some
certaine meats
& particular-
ly cheefe.

he was a child, had like to have died of drought, before his nurse came to understand, that he had an antipathy against Beer or Wine; untill the tender nature in him, before he could speak, taught him to make earnest signes for water, that by accident he saw; the greedy drinking of which, cured presently his long languishing and pining sicknesse: and such examples are very frequent.

The cause of these effects many times is, that their mothers, upon their first suppression of their usuall evacuations, by reason of their being with child took some strong dislike to such things, their stomacks being then oppressed by unnatural humors, which overflow their bodies upon such retentions; and which make them oftentimes sick and prone to vomiting, (especially in the mornings, whiles they are fasting) and sometimes to desire earnestly (which they call *longing*) to feed upon some unwholesome, as well as some particular wholesome things; and other whiles, to take aversion against meates, which at other seasons they affected well. Now the child being nourished by the so imbued blood of the mother, no wonder if it taketh affections or dislikes, conformable to those which at that present raigne in the mother: the which for the most part used to be purged away, or are overwhelmed by the maistring qualities of better aliments succeeding: but if by some mischance, they become too much grafted in the childs stomack, or in some other part, through which the masse of blood must passe; then the child getteth an aversion from those meates: and we often see, that people retain a strong conversion to such meates or drinks, as their mothers affected much or longed for, whiles they bred child of them.

And thus we will leave this particular; adding only one note, why there are more persons generally, who have antipathy against cheese, then against any one sort of meat besides whatsoever. A principall reason of which symptome (where the precedent one hath not place) I conceive to be that their nurses prov'd with child, whiles they gave them suck: for I have by experience found it to have bee so, in as many as I have made inquiry into. And it is very conformable to reason; for the nurses milk, curdling in her breast upon her breeding of child, & becoming very offensive to the chilles tender stomack, (whose being sick, obligeth,

obligeth the parents to change the Nurse, though peradventure they know nothing of the true reason that maketh her milke unnaturall) he hath a dislike of Cheefe (which is strong curdled milk) ever after settled in him; as people that have once surfeited violently of any meat, seldome arrive to brooke it again.

Now, as concerning those Animals who lay up in store for winter, & seem therein to exercise a rationall providence; who seeth not, that it is the same humour, which moveth rich milers to heap up wealth, even at their last gasp, when they have no child nor friend to give it to, nor think of making any body their heires? Which actions because they have no reason in them, are to be imputed to the passion or motion of the materiall appetite. In the doing of them, these steppes may be obserued; first the object presenting it self to the Eye provoketh love and desire of it; especially if it be joyned with the memory of former want: then, this desire stirreth up the animal (after he hath fed himself) together into the place of his chief residence, as much of that desired object as he meeteth withall; and whensoever, his hunger returning, bringeth back into his fantasy the memory of his meat, it being joyned with the memory of that place (if he be absent from it) he presently repaireth thither, for relief of what presseth him: (and thus Dogs when they are hungry, do rake for bones they had hidden when their bellies were full.) Now if this food, gathered by such providence (which is nothing else, but the conformity of it working upon him by his sence) and layed up in the place where the owner of it resideth, (as the corne is which the Ants gather in summer) be easily portable, he will carry it abroad with him the first time he stirreth after a long keeping in; for then nothing worketh so powerfully in his fantasy, as his store; and he will not easily part from it, though other circumstances invite him abroad. From hence it proceedeth, that when a faire day cometh after long foule weather, the Ants, who all that while kept close in their dennes with their corne lying by them, do then come abroad in the Sun, and do carry their graine along with them: or peradventure it happeneth, because the precedent wet weather, hath made it grow hot, or musty, or other-

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Concerning
the provi-
dence of Ants
in laying up
in store for
winter.

wife offensive within; and therefore they carry it out, as soon as themselves dare peep abroad; which is, when the faire weather and heat of the day, inviteth them out into the open ayr: and before night that they return into their holes, the offensive vapors of the corne are exhaled and dried up, and move their fantasies no longer to aversion, whereupon they carry it back again; having then nothing but their long contracted love unto it to work upon them. The like whereof men doing by discourse, to ayr their corne, and to keep it sweet, and the same effect following herein, they will presently have it, tho' this is done by the Ants, for the same reason, and by designe. Then the moysture of the earth swelling the graine, and consequently, making it begin to shoot at the ends (as we declared, when we spoke of the generation of plants, and as we see in the moystening of corne to make malt of it) those little creatures, finding that part of it more tender and jicy then the rest, do nibble upon it there, and do feed themselves first with that, which consequently hindereth the growth of the corne. And here again, men will contend that this must be done by providence and discourse, to prevent that their store should not grow out of their reach, and changing nature, become uselesse to them in their need.

10
Concerning
the foreknow-
ing of Beasts.

To conclude, the foreknowing of beasts is nothing else, but their timely receiving impressions, from the first degrees of mutation in things without them; which degrees are almost imperceptible to us, because our fantasies & spirits, have otherwise such violent agitations, more then theirs, which hinder them from discerning gentle impressions upon them. If you be at Sea, after a long calme, a while before a gale bloweth to fill your sailes, or to be discernable by your sense in quality of wind, you shall perceive the Sea begin to wrinkle his smooth face that way the wind will come; which is so infallible a signe that a gale will come from that coast, as mariners immediately, fall to trimming their sailes accordingly; and usually, before they can have done, the wind is with them: shall we therefore say that the Sea hath a providence to foresee which way the wind will blow? Or that the cornes upon our toes, or calluses, or broken bones or joynts that have been dislocated, have discourse, & can fore-
tell,

tell the weather? It is nothing else, but that the wind rising by degrees, the smooth Sea is capable of a change by it, before we can feele it: and that the Ayr, being changed by the forerunners of worse weather, worketh upon the crashest parts of our body, when the others feele not so smal a change: so beasts are more sensible then we (for they have lesse to distract them) of the first degrees of a changing weather: and that mutation of the Ayr without them, maketh some change within them, which they expresse, by some outward actions or gestures.

Now they who observe, how such mutations and actions, are constantly in them before such or such weather, do think they know beforehand, that rain (for example) or wind, or droucht is comming, according to the severall signes they have marked in them: which proceedeth out of the narrowness of their discourse, that maketh them resort to the same causes, whensoever they meet with like effects: & so they conceive, that things must needs passe in beasts, after the same tenour, as they do in men. And this is a generall, and main errour, running through all the conceptions of mankind, unlesse great heed be taken to prevent it, that what subiect soever they speculate upon, whether it be of substances, that have a superiour nature to theirs, or whether it be of creatures inferiour to them, they are stil apt to bring them to their own standard, and to frame such conceptions of them, as they would do of themselves: as when they will have Angels discourse, and move and be in a place, in such sort as is naturall to men; or when they will have beasts ratiolate and understand, upon their observing some orderly actions performed by them, which in men would proceed from discourse and reason. And this dangerous Rock (against which many fine conceptions do suffer shipwrack) whosoever studieth truth must have a main caution to avoyd.

*Sed nos immensum spatium confecimus æquor:
Et jam tempus equum summa solvere colla.*

Hh 4

THE



THE
CONCLUSION
OF THE
FIRST TREATISE.

THus at the last (by Gods assistance) we have climbed up to the top of the hill; from whence looking down over the whole region of bodies, we may delight our selves, with seeing what a height the weary steps we ascended by, have brought us unto. It is true, the path we have walked in, is of late so untrodden, and so overgrown with bryars, as it hath not been without much labour, that we have made our way through. And peradventure, it may seem toyle some unto others to follow us, especially such as are not much enured to like journeys: but I hope, the fruit which both we and they are now arrived together of our paines, in this generall view we have taken of the empire of matter, and of corporeal agents, is such, as none of us hath reason to be ill satisfied with the imploying of them. For what can more powerfully delight, or more nobly entertaine an understanding soul, then the search and discovery of those works of nature, which being in their effects so plainly exposed to our eyes, are in their causes so abstruse and hidden from our comprehension, as (through dispaire of successe) they deter most men from enquiring into them?

And

And I am perswaded, that by this summary discourse (short indeed, in regard of so large a scope, how ever my lame expressions may peradventure make it appeare tedious) it appeareth evidently, that none of natures greatest secrets, whereof our senses give us notice in the effects, are so over shaded with an impenetrable veile, but that the diligent & wary hand of reason might unmaske them and shew them to us, in their naked and genuine formes, and delight us with the contemplation of their native beauties; if we had as much care and constancy in the pursuit of them, as we daily see men have in heaping up of wealth, or in striving to satisfie their boundlesse ambitions; or in making their senses swim in the muddy lake of base and contemptible pleasures. For who shall thoroughly consider and weigh what we have hitherto said, will plainly see a continuall and orderly progresse, from the simplest, highest, and most common conception, that we frame of a body in generall, unto the furthest and most abstruse effects, that in particular are to be found in any body whatsoever: I mean, any that is meerely corporeal, without mixture of a nobler nature; for hitherto we have not moved, nor so much as looked out of that Orbe: He shall finde one continued thread, spunne out from the begining to the end. He will see, that the various twisting of the two specieses of *Bodies*, *rare*, and *Dense*, do make the yarne, of which all things and actions with the sphere of matter are woven.

And although peradventure, in the drawing out of the thread, there may be some little brækes, or the stuffe made of it be not every where so close wrought, as a better workman at more leisure might have done; yet truely, I believe, that the very consent of things throughout is such, as demonstrateth, that the maine contexture of the doctrine I have here touched, is beyond quarrelling at. It may well be that in sundry particulars, I have not lighted upon exact truth: and I am so farre from maintaining peremptorily any thing I have here said, as I shall most readily hearken to whatsoever shall be objected against it; and be as ready upon cause, to desert my own opinions, and to yeeld unto better reason. But withall, I conceive,

ceive, that as the falling of a brick here and their in the rearing of the walls of a house, doth nothing at all prejudice the strength and security of the fabricke; no more (I hope) will the slight escapes, which so difficult a taske as this is subject unto, endamage or weaken the main body of what I have here delivered. I have not yet seen any piece upon this subject made up with this method, beginning from the simplest and plainest notions, and composing them orderly, till all the principall variety which their nature is capable of, be gone through: and therefore it cannot be expected, but that the first modell of this kind (and moulded by one distracted with continueall thoughts of a much different straine; and whose exercise, as well as profession, hath allowed him but little commerce with bookes and study) must needs be very rough hewed, and require a great deale of polishing. Which whosoever shall do, and be as exact and orderly in treating of Philosophy and Theology, as Mathematicians are in delivering their sciencies, I do assure my self, that *Demonstrations* might be made, and would proceed in them as currantly, and the conclusions be as certaine and as full, as in the Mathematicks themselves. But that is not all: these demonstrations would have the oddes exceedingly of the other, and be to us inestimably more advantagious: for out of them, do spring much higher and nobler effects, for mans use and life, then out of any Mathematicall ones; especially when they extend themselves to the government of *Man* as he is *Man*: which is an art, as farre, beyond all the rules of Physick, or other government of our body, or temporall goods, as the end is beyond the meanes, we employ to gain it; for all the others, do but serve instrumentally to this end, *That we may live well*: whereas these do immediately teach it.

These are the fruits in generall, that I hope may in some measure, grow out of this discourse, in the hands of equal and judicious Readers: but the particular ayme of it, is to shew what actions can proceed from a body, and what cannot. In the conduct whereof, one of our chief endeavours hath been to shew, that those actions which seem to draw strongly in-
to

to the order of bodies, the unknown nature of certaine Entities named *Qualities*; either do or may proceed, from the same causes, which produce those known effects, that all sides agree, do not stand in need of any such mysticall Philosophy. And this being the main hinge, upon which hangeth & moveth the full and clear resolving of our main, and great question, *Of the immortality of the soule*; I assure my self, the paines I have taken in this particular, will not be deemed superfluous or tedious: and withall, I hope I have employed them with so good successe, as henceforward, we shall not be any more troubled, with objections drawn from their hidden and incomprehensible nature: and that we stand upon even ground, with those of the contrary opinion: for since we have shewed, how all actions may be performed among bodies, without having any recourse to such *Entities & Qualities* as they pretend and paint out to us, it is now their part (if they will have them admitted) to prove that in nature there are such.

Having then brought the Philosophy of bodies unto these termes; that which remaineth for us to performe, is to shew that those actions of our soul, for which we call her a spirit, are of such a nature, as they cannot be reduced into those principles, by which all corporeal actions are effected. For the proof of our original intent, no more then this, can be exacted at our hands; so that if our positive proofes, shall carry us yet beyond this, it cannot be denied, but that we give over measure, and do illustrate with a greater light, what is already sufficiently discerned. In our proceeding, we have the precedency of nature; for laying for our ground the naturall conceptions which mankind maketh of quantity; we finde that a body is a meere passive thing, consisting of divers parts which by motion may be diversly ordered; and consequently that it is capable of no other change or operation, then such as motion may produce, by various ordering the divers parts of it: and then, seeing that *Rare and Dense*, is the primary and adequate division of *Bodies*; it followeth evidently that what cannot be effected by the various disposition of rare and dense parts; cannot proceed or be effected by a pure body

body : and consequently, it will be sufficient for us to shew, that the motions of our soules are such : and they who will not agree to this conclusion, must take upon them to shew, that our first premiss is defective ; by proving that ether unknown waies are necessary, for bodies to be wrought upon, or to work by : and that the motion, and various ordering of rare and dense parts in them, is not cause sufficient for the effects we see among them. Which whosoever shall attempt to do, must remember that he hath this disadvantage before he beginneth, that whatsoever hath been hitherto discovered in the science of bodies, by the help either of Mathematicks or Physicks, it hath all been resolved, & hath fallen into this way which we declare.

Here I should set a period to all further discourse concerning this first Treatise of bodies, did I not apprehend, that the prejudice of Aristotles authority, may dispose many to a harsh conceit of the draught we have made. But if they knew how little reason they have to urge that against us, they would not cry us, down for contradicting that Oracle of nature : not onely because he himself, both by word, and by example, exhorteth us, when verity leadeth us another way, to forsake the tricks which our forefathers have beaten for us, so we do it with due respect and gratitude for the much they have left us : nor yet because Christian Religion, as it will not heare of any man (purely a man) free from sin, so it inclineth to perswade us, that no man can be exempt from error ; and therefore it favoureth not well, to defend peremptorily any mans sayings (especially if they be many) as being uncontrollable ; howbeit I intend not to prejudice any person, that to defend a worthy Authors honour, shall endeavour to vindicate him from absurdities & grosse errors : nor lastly, because it hath ever been the common practise of all grave Peripateticks & Thomists, to leave their Masters, some in one article, some in another : but indeed, because the very truth is, that the way we take, is directly the same solid way, which Aristotle walked in before us : and they who are scandalised at us for leaving him, are exceedingly mistaken in the matter : and out of the

the sound of his words (not rightly understood) do frame wrong sense of the doctrine he hath left us which generally we follow.

Let any unpartiall Aristotelian answer, whether the conceptions we have delivered of *Quantity*, of *Rarity* and *Density*, of the *four first Qualities*, of the combinations of the *Elements*, of the repugnance of *vacuities*, be not exactly and rigorously Aristotles? Whether the motion of weighty and light things, and of such as are forced, be not by him, as well as by us, attributed to externe causes? In which all the difference between us is, that we enlarge our selves to more particulars then he hath done. Let any man read his bookes of *Generation* and *Corruption*, and say whether he doth not expressely teach, that mixtion (which he delivereth to be the generation or making of a mixt body) is done *per minima*; that is in our language and in one word, by atomes; and signifyeth, that all the qualities, which are naturall qualities following the composition of the *Elements*, are made by the mingling of the least parts or atomes of the said *Elements*; which is in effect to say; that all the nature of bodies, their qualities, and their operations, are compassed by the mingling of atomes: the shewing and explicating of which, hath been our labour in this whole *Treatise*. Let him read his bookes of *Meteors*, and judge whether he doth not give the causes of all the effects he treateth of there, by mingling and separating of great and little, grosse and subtile, fiery and watery, ayery and earthy parts, just as we do. The same he doth in his *Problems*, and in his *Parva naturalis*, and in all other places, wheresoever he hath occasion to render Physically, the causes of Physicall effects. The same do Hippocrates and Galen: the same, their Master Democritus; and with them the best sort of Physicians: the same doe Alchymistes, with their master Geber; whose maxime to this purpose, we cited above: the same do all naturall Philosophers, either ancient commentatours of Aristotle, or else moderne enquirers into naturall effects, in a sensible and understandable way: as who will take the paines to look into them, will easily perceive. Wherefore, let any judicious Reader that hath looked further into Aristotle then onely upon

upon his Logickall and Metaphysicall workes, judge whether in *bulke* our Doctrin be not conformable to the course of his, and of all the best Philosophers that have been and are; though in *detaile* or particulars, we sometimes mingle therewith, our own private judgements as every one of them, hath likewise shewed us the way to do, by the liberty themselves have taken to dissent in some points from their predecessors.

And were it our turne, to declare and teach Logick and Metaphisickes, we should be forced to go the way of *matter*, and of *formes*, and of *privations*, in such sort as Aristotle hath trodden it out to us, in his workes of that straine. But this is not our taske for the present; for no man that contemplateth nature as he ought, cannot choose but see that these notions are no more necessary, when we consider the framing of the elements, then when we examin the making of compounded bodies: and therefore, these are to be set a part as higher principles, and of another straine, then need be made use of for the actuall composition of compounded things, and for the resolution of them in their materiall ingredients, or to cause their particular motions; which are, the subjects we now discourse of.

Upon this occasion, I think it not amisse to touch, how the latter sectatours, or rather pretenders of Aristotle, (for truly they have not his way) have introduced a modell of doctrine (or rather of ignorance) out of his words, which he never so much as dreamed of; howbeit they alledge texts out of him to confirme what they say, as Heretickes do out of Scripture to prove their assertions: for whereas he called certaine collections or positions of things, by certaine common names (as the art of Logick requireth) terming some of them *Qualities*, others *Actions*, others *Places*, or *Habites*, or *Relatives*, or the like: these his latter followers, have conceited that these names did not designe a concurrence of sundry things, or a divers disposition of the parts of any thing, out of which some effect resulted; which the understanding considering all together, hath expressed the notion of it by one name

name : but have imagined, that every one of these names had correspondent unto it some reall positive entity or thing, seperated (in its own nature) from the main thing or substance in which it was, and indifferent to any other substance; but in all unto which it is linked, working still that effect, which is to be expected from the nature of such a *quality*, or *action*, &c. And thus, to the very negatives of things, as to the names of points, lines, instants, and the like, they have imagined positive Entities to correspond : likewise, to the names of *actions*, *places*, and the like, they have framed other Entities : as also to the names of *colours*, *sounds*, *tastes*, *smells*, *touches*, and the rest of the *sensible qualities*, they have unto every one of them, allotted speciall Entities, and generally to all qualities whatsoever. Whereas nothing is more evident, then that Aristotle meant by *qualities* no other thing, but that disposition of parts, which is proper to one body, and is not found in all : as you will plainly see, if you but examin, what *beauty*, *health*, *agility*, *science*, and such other qualities are ; (for by that name he calleth them ; and by such examples giveth us to understand what he meaneth by the word *Quality*) the first of which is nothing else but a composition of severall parts and colours, in due proportion to one another : the next, but a due temper of the humours, and the being of every part of the body, in the state it should be : the third, but a due proportion of the spirits and strength of the sinewes : and the last, but ordered Phantasmes.

Now when these perverters of Aristotle have framed such Entities, under that conception which nature hath attributed to substances, they do immediately upon the nick, with the same breath that described them as substances, deny them to be substances : and thus they confound the first apprehensions of nature, by seeking learned and strained definitions for plain things. After which they are faine to look for gliew and paste to joyn these Entities unto the substance they accompany : which they finde with the same facility, by imagining a new Entity, whose nature it is to do that which they have need of.

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And this is the generall course of their Philosophy; whose great subtilty, and quaint speculations in enquiring how things do come to passe afford no better satisfaction then to say upon every occasion, that there is an *Entity* which maketh it be so. As if you aske them, how a wall is white or black? They will tell you, there is an *Entity* or *Quality*, whose essence is to be whitenesse or blacknesse, diffused through the wall. If you continue to aske, how doth whitenesse stick to the wall? They reply, that it is by means of an *Entity* called *Union*, whose nature it is actually to joyne whitenesse, and the wall together. And then if you enquire how it commeth to passe, that one white is like another? They will readily answer, that this is wrought by another *Entity*, whose nature is to be *likenesse*, and it maketh one thing like another. The consideration of which doctrine, maketh me remember a ridiculous tale of a trowant schoolboyes latine: who upon a time when he came home to see his friends, being asked by his father, what was latine for bread? answered *bredibus*; and for beere? *beeribus*; and the like of all other things he asked him, adding onely a termination in *bus*, to the plaine English word of every one of them: which his father perceiving, and (though ignorant of Latine) yet presently apprehending, that the mysteries his sonne had learned, deserved not the expence of keeping him at schoole, bad him immediately put off his *hosibus* and *shoesibus*, and fall to his old trade of treading *Morteribus*. In like manner, these great Clarks do as readily find a pretty *Quality* or mood, whereby to render the nature or causes of any effect in their easie Philosophy, as this Boy did a *Bus* to stamp upon any English word, and coyn it into his mock latine.

But to be serious, as the weight of the matter requireth, let these so peremptory pretenders of Aristotle, shew me but one text in him, where he admitteth any middle distinction (such as those modern Philosophers do, and must needs admit, who maintaine the qualities we have rejected) betwixt that which he calleth *Numericall*, and that which he calleth of *Reason*, or of *Notion*, or of *Definition*, (the first of which we may terme to be of or in things; the other to be in our heads, or discourses: or the one

One *Natural*, the other *Logical*;) and I will yield that they have reason, and that I have grossely mistaken what he hath written, and that I do not reach the depth of his sense. But this they will never be able to do.

Besides, the whole scope of his doctrine, and all his discourses and intentions, are carried throughout, and are built upon the same foundations, that we have laid for ours. Which being so, no body can quarrel with us for *Aristotles* sake; who as he was the greatest Logician, and Metaphysician, and universal Scholar peradventure that ever lived; and was so highly esteemed, that the good turn which *Sylla* did the world in saving his works, was thought to recompence his many outrageous cruelties and tyranny; so his name must never be mentioned among Scholars, but with reverence, for so unparalleled worth; and with gratitude, for the large stock of knowledge he hath enriched us with. Yet withall we are to consider, that since his reign was but at the beginning of sciences, he could not choose but have some defects and shortnesses, among his many great and admirable perfections.

THE SECOND
TREATISE:
DECLARING,
THE NATURE
AND
OPERATIONS
OF
MANS SOUL;
OUT OF WHICH,
THE IMMORTALITY
OF
REASONABLE SOULS,
IS CONVINCED.

Pro capite Lectoris, habent sua fata libelli.

LONDON,
Printed in the year 1657.

THE SECOND
TREATISE

DEALING
THE NATURE
AND
OPERATIONS

OF
MANS SOUL

OUT OF WHICH
THE IMMORTALITY

OF
REASONABLE SOULS
IS CONFINED

The author's last will and testament

LONDON

Printed in the Year 1657



THE PREFACE.



It is now high time for us to cast an eye upon the other leaf of our accounts: or peradventure I may more properly say, to fall to the perusal of our own accounts: for hitherto, our time and pains have been taken up, in examining and casting the accounts of others: to the end, that from the foot and total of them, we may drive on our own the more smooth-

ly. In ours then, we shall meet with a new Capital; we shall discover a new World, of a quite different strain and nature from that which all this while we have imployed our selves about. We will enter into them, with taking a survey of the great Master of all that large family, we have so summarily viewed: I mean of Man, as he is Man: that

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is, not as he is subject to those laws, whereby other bodies are governed (for therein he hath no preeminence, to raise him out of their throng :) but as he exceedeth the rest of creatures, which are subject to his managing ; and as he ruleth over nature herself, making her serve his designs ; and subjecting her noblest powers to his laws ; and as he is distinguished from all other creatures whatsoever. To the end we may discover, whether that principle in him, from whence those actions do proceed which are properly his, be but some refined composition, of the same kind we have already treated of : or whether it deriveth its source and origine from some higher spring and stock, and be of a quite different nature.

Having then by our former Treatise mastered the oppositions, which else would have taken arms against us, when we should have been in the midst of our edifice ; and having cleared the objections which lay in our way, from the perverse Qualities of the sou's neighbours, the several common-wealths of Bodies: we must now being with David to gather together our Materials, and to take a survey of our own provisions : that so we may proceed with Salomon, to the sacred building of Gods Temple. But before we go about it, it will not be amiss, that we shew the reason, why we have made our porch so great, and have added so long an entry, that the house is not likely to have thereunto a correspondent bulk : and when the necessity of my doing so, shall appear, I hope my pains will meet with a favorable censure, and receive a fair admittance.

We proposed unto our selves to shew that our souls are Immortal : whereupon, casting about to find the grounds of immortality, and discerning it to be a negative, we conceived that we ought to begin our search, with enquiring what mortality is, and what be the causes of it. Which

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when we should have discovered, and have brought the soul to their test, if we found they trenched not upon her, nor any way concerned her condition, we might safely conclude, that of necessity she must be immortal. Looking then into the causes of mortality, we saw that all bodies round about us were mortal: whence perceiving that mortality extended it self as far as corporeity, we found our selves obliged, if we would free the soul from the law, to shew that she is not corporeal. This could not be done without enquiring what corporeity was. Now it being a rule among Logicians, that a definition cannot be good, unless it comprehend and reach to every particular of that which is defined; we perceived it impossible to know compleatly, what a Body is, without taking a general view of all those things which we comprise under the name and meaning of Bodies. This is the cause we spent so much time in the first Treatise: and I hope to good purpose; for there we found that the nature of a Body, consisted in being made of parts: that all the differencies of bodies are reduced to having more or less parts, in comparison to their substance, thus and thus ordered: and lastly, that all their operations, are nothing else but local motion, which followeth naturally out of having parts. So as it appeareth evidently from hence, that if any thing have a being, and yet have no parts, it is not a body, but a substance of another quality and condition: and consequently, if we can find the souls Being to be without parts, and that her operations are no local translation; we evidently conclude her to be an immaterial or spiritual substance.

Peradventure it may be objected, that all this might have been done a much shorter way than we have taken; and that we needed not have branched our discourse, into so many particulars, nor have driven them so home, as we have done: but that we might have taken our first rise from this ground,
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(which is as evident, as light of reason can make it) that seeing we know Bignets and a Body, to be one and the same, as well in the notion as in the thing; it must of necessity follow, that what hath not parts, nor worketh, nor is wrought upon by division, is not a body. I confess, this objection appeareth very reasonable, and the consideration of it weighed so much with me, as, were all men of a free judgment, and not imbued with artificial errors, I would for its sake, have saved my self a great deal of pains: but I find (as in the former Treatise I have frequently complained of) that there is crept into the world a fansie so contrary to this pregnant truth, and that it is so deeply settled in many mens minds (and not of the meanest note) as all we have said is peradventure too little to root it out.

If any that being satisfied with the rational maxim we even now mentioned, and therefore hath not deemed it needfull to imploy his time in reading the former Treatise, should wish to know how this is come to pass, I shall here represent unto him, the sum of what I have more at large scattered in several places of the former Treatise; and shall intreat him to consider, how nature teacheth us to call the proprieties of things whereby one is distinguished from another, the Qualities of those things; and that according to the varieties of them, they have divers names suited out to divers of them; some being called Habits, others Powers, and others by other names. Now what Aristotle, and the learned Grecians did mean by these things is cleer by the examples they give of them: they term Beauty and Health, Habits, the dispositions of our bodies to our bodily motions, Powers; as strength (which is the good temper of the sinews) a Power; likewise Agility a Power; so they use the names of the concoctive, the nutritive, the retentive, the excretive, Power; the health of the eyes, the ears, the nosethrils, &c. they

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they call the Powers of Seeing, of Hearing, of Smelling, &c. and the like of many others. But latter philosophers being very disputative, and desiring to seem ignorant of nothing (or rather, to seem to know more than any that are gone before them, and to refine their conceptions) have taken the notions, which by our first Masters were set for common and confused explications of the natures, (to serve for convenience and succinctness of discourse) to be truly and really particular Entities, or things of themselves: and so have filled their Books, and the Schools, with unexplicable opinions, out of which no account of nature can be given: and which is worse, the way of searching on, is barred to others; and a mischievous error is grown into mens beliefs, that nothing can be known. By this means they have choaked the most plain and evident definition of a Body; bringing so many instances against it, that unwary men are forced to desert and deny the very first notions of nature and reason: for in truth, they turn all bodies into spirits, making (for example) heat, or cold, to be of it self indivisible, a thing by it self, whose nature is not conceivable; not the disposition or proportion of the parts of that body which is said to be hot or cold; but a real thing, that hath a proper Being and nature peculiar to it self; whereof they can render you no account, and so may as well be against the notion of a body as not: for if light, the vertue of the loadstone, the power of seeing, feeling, &c. be things that work without time, in an instant; if they be not the dispositions of parts as parts, (whose nature is, to be more or less, to be next or far off, &c.) how can it be truly said, that the notion of a body, is to be of parts? For if this be a true definition of a body, it followeth that all corporeal qualities and actions must likewise be some disposition and order of parts as parts: and that what is not so, is no body, nor bodily quality or propriety.

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This then was it that obliged me to go so far abou, and to shew in common, how all those effects which are so much admired in bodies, are, or may be made and continued by the sole order of quantitative parts and local motion: this hath forced us to anatomize nature, and to begin our dissection, with what first occurreth our sense from a body. In doing which, out of the first and most simple notion of Bigness or Quantity, we found out the prime division of Bodies, into rare and Dense: then finding them to be the qualities of dividing and of being divided (that is of local motion) we gained knowledge of the common properties of Gravity and Levity: from the combination of these, we retrived the four first Qualitie: and by them, the Elements. When we had agreed how the elements were made, we examined how their action & composition raiseth those second qualities, which are seen in all mixt bodies, and do make their divisions. Thence, proceeding into the operations of life, we resolved, they are composed & ordered meerly by the varieties of the former: nay, that sense and fantasy (the highest things we can discern out of man) have no other source, but are subject to the Lawes of parts and of Rarity and Density; so that in the end we became assured of this important Maxime: That nothing whatsoever we know to be a Body, can be exempted from the declared Laws, and orderly motions of Bodies, unto which, let us add two other positions, which fell also within our discovery: the first that it is constantly founded in nature, that none of the bodies we know, do move themselves; but their motion must be founded in some thing without them: the second, that no body moveth an other, unless it self be also moved & it will follow evidently out of them (if they be of necessity & not prevaricable) that some other Principle

beyond

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beyond bodies, is required to be the root and first ground of motion in them: as Mr. White hath most ascetely and solidly demonstrated, in that excellent work I have so often cited in my former Treatise.

But it is time we should fall to our intended discourse, leaving this point settled by what we have already said, that if we shew our soul, and her operations, to be not composed of parts, we also therein conclude, that she is a spiritual substance, and not a body. Which is our design and intention in this Treatise.

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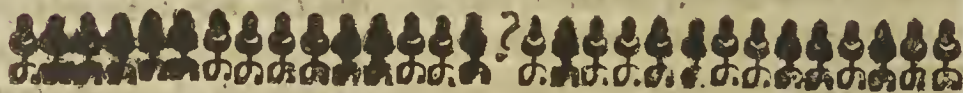
Nudo 2^{do}.

And for this intent, we must look upon those actions of men, which are peculiarly his: and upon those things which result out of them, and are called, Opera, or labores hominum; as Houses, Towns, Tillage Handicrafts, Armes, Ships common-wealths, Armies, Books, and the like; in which great mens lives and thoughts have been spent. In all these we find one general thred, to run quite through them; & that all of them are composed of the same stuff, & are built upon the same foundation: which is, a long chain of discourses, whereof every little part or link is that which schollers do call a Syllogisme: and Syllogismes we know are framed of enuntiations; and they of single or uncomposed apprehensions. All which are actions wrought by the understanding of a man. But beyond these, we cannot proceed to any farther subdivision of parts, and continue our selves within the Orbe of human Actions; for simple apprehensions cannot be farther resolved into other parts, beyond the degree of apprehensions, and yet still remain actions peculiar to a man so that we may be sure, we shall have left nothing out of enquiry, concerning Mans actions as he is Man, if we begin with anatomizing his first bare apprehensions; and so go on by degrees, compounding them, till we come to faddom those great and admirable machines of books and works, which
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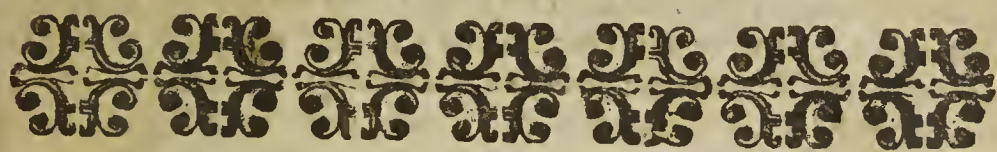
he (as I may say) weaveth out of his own bowels; & the like which, is don by no other creature whatsoever, upon the face of our contemptible Earth.

These then (which are all comprised under the names of Apprehensions, of Enuntiations or Judgements, and of Discourses) shall be the subject of this second Treatise: and in it we will first consider these operations in themselves; which being done, we will endeavour to prove out of the nature and manner of performing them, that the souls unto whom they belong, are Immaterial and Immortal.



THE





THE SECOND TREATISE :

DECLARING

The nature and operations of Mans Soul.

THE FIRST CHAPTER.

Of simple Apprehensions.

THat we may duly understand, what a right Apprehension is, let us consider the preeminence that a man who apprehendeth a thing rightly, hath over him who misseeth of doing so. This latter can but rove wildly at the nature of the thing he apprehendeth; and will never be able to draw any operation into act, out of the apprehension he hath framed of it. As for example: if a man be to work upon gold, and by reason of its resemblance unto brasse, hath formed an apprehension of brasse, instead of an apprehension of gold, and then (knowing that the action of fire, will resolve brasse into its least parts, and sever its moist from its dry ones) will go about to calcine gold in the same manner as he would do brasse; he will soon finde that he loseth his labour; and that ordinary fire is not an adequate Agent to destroy the homogenous nature, and to sever the minute parts of that fixed metall: all which happeneth, out of the wrong apprehension he hath made of gold. Whereas on the other side, he that apprehendeth a thing rightly, if he pleaseth to discourse of what he apprehendeth, findeth in his apprehension all the parts and qualities, which are in the thing he discourseth of: for example, if he apprehendeth rightly a knife, or a beetle, or a five, or any other thing whatsoever; in the *knife* he will finde *hilt* and *blade*; the blade of iron, thick on the back, and thin on the edge; tempered to be hard and tough; thus beaten, so ground, in such manner softned, thus quenched, and whatsoever else concerneth

I.

What is a right apprehension of a thing

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neth the *being* or the making of a knife : and all this he draweth out of his notion or apprehension of a knife ; which is, *that it is an instrument fitted to cut such and such things, in such a manner* : for hence he findeth, that it hath an haft, fit to hold it by in ones hand, to the end it may not hurt the hand, whiles it presseth upon the knife ; and that the blade is apt to slide in betwixt the parts of the thing which is to be cut, by the motion of being pressed or drawn by the hand ; and so he proceedeth on, descending to the qualities of both parts ; and how they are to be joyned, and held fast together. In the like manner, he discourseth of a beetle, of a sive, or of whatsoever else cometh in his way. And he doth this, not onely in such manufactures as are of mans invention ; but (if he be capable) he doth the like in beasts, in birds, in trees, in herbs, in fishes, in fossiles, and in what creature soever he meeteth withal, within the whole extent of nature. He findeth what they are made for : and having discovered Natures time in their production, he can instruct others, what parts and manner of generation they have, or ought to have : and if he that in this manner apprehendeth any thing rightly ; hath a minde to work upon it, either to make it, or to use and order it to some end of his own ; he is able by his right apprehension, to compare it unto other things ; to prepare what is any way fitting for the making of it ; to apply it unto what it will work its effect upon ; and to conserve it from what may wrong or destroy it : so, if he have framed a right apprehension of a sive, he will not employ it in drawing water ; if of a beetle, he will not go about to cut with it ; neither will he offer, if he have a due apprehension of a knife, to cut stone or steel with it, but wood, or what is softer. He knoweth what will whet and maintain the edge of it ; and understandeth what will blunt or break it : In fine, he useth it in such sort, as the knife it self (had it knowledge and will) would wish to be used ; and moveth it in such a manner, as if it had power of motion, it would move it self : he goeth about the making it, even as nature would do, were it one of her plants : and in a word, the knife in this apprehension made in the man, hath those causes, proprieties, and effects, which are natural unto it ; and which nature would give it, if it were made by her ; and which are proportionable to those parts, causes, proprieties and effects, that nature bestoweth on her children and creatures, according to their several essences.

What

What then can we imagine, but that the very nature of a thing apprehended, is truly in the man, who doth apprehend it? And that to apprehend ought, is to have the nature of that thing within ones self? And that man, by apprehending, doth become the thing apprehended; not by change of his nature unto it, but by assumption of it unto his?

2.
The very thing it self is truly in his understanding who rightly apprehendeth it.

Here peradventure some will reply, that we press our inference too far: and will peremptorily deny the things real being in our mind, when we make a true and full apprehension of it; accounting it sufficient for our purpose, that some likeness, or image of the thing be there; out of which, we may draw all these, whether contemplations, or works, or disposals of the thing. But by that time this objection is thoroughly looked into, and that so much as they allow is duly examined, I believe we shall finde our quarrel to be onely about the word, not about the matter: and that indeed, both of us do mean the same, howbeit diversly conceived: and that in substance their expression, in what they grant, importeth the same as ours doth: which, it is true, they first deny in words; but that may be, because the thing is not by them rightly understood.

Let us then discuss the matter particularly. What is likeness, but an imperfect unity between a thing, and that which it is said to be like unto? If the likeness be imperfect, it is more unlike than it is like unto it: and the liker it is, the more it is one with it; until at length, the growing likeness may arrive to such a perfection, and to such an unity with the thing it is like unto, that then, it shall no longer be like, but is become wholly the same, with that formerly it had but a resemblance of. For example, let us consider, in what consisteth the likeness unto a man, of a picture drawn in black and white representing a man: and we shall find, it is onely in the proportion of the limbs and features; for the colours, the bulk, and all things else are unlike; but the proportions are the very same, in a man and in a picture; yet that picture is but a likeness, because it wanteth bigness and colour: give it them, and nevertheless it will be but a likeness, because it wanteth all the dimensions of corporeity or bulk, which are in a mans body: add also those to it; and still it will be but a likeness or representation of a man, because it wanteth the warmth, the softness, and the other qualities

of a living body, which belong to a man : but if you give all these, then it is no longer a likeness or image of a living creature, but a living creature indeed; and if peradventure this living creature do continue still to be but the likeness of a man, it is because it wanteth some perfections or proprieties belonging to a man : and so in that regard, is unlike a man: but if you allow it all those, so that in nothing it be unlike, then your taking away all unlikeness, taketh away likeness too : and as before of dead, it became a living creature, so now of another living creature, it becometh a man, and is no longer like a man. You see then plainly the reason, why that, which we call *a like thing*, is not *the same*; for in some part it is dislike : but if the likeness were compleat in every regard, then it were no longer to be called *like*, but the very thing it self : and therefore we may conclude, that if the likeness of a thing, which the objection alloweth to be in our knowledge, do contain all that is in the thing known, then it is in truth, no more a likeness, but the very known thing it self : and so what they grant, amounteth to as much as we require; though at the first they go about to exclude it.

3. Having thus concluded, that when we apprehend any thing, that very thing is in us; let us in the next place examine, how it cometh thither, and what it is there. Which we shall best do, by anatomising, and looking narrowly into the nature of such apprehensions, as we daily make of things. It is true, we said even now, that we cannot divide the actions of mans mind, farther into apprehensions; and therefore we called them simple and uncompounded : and with good reason; for if we reflect upon the operations of our mind, we shall evidently perceive, that our bare apprehensions, and only they, are such : but withal we must acknowledge, that all the apprehensions we make of things coming unto us by our senses, are composed of other more single apprehensions, and may be resolved into them : all which are as it were the limbs and parts, that make up and constitute the other total one.

4. Let us make use of our former example, and dissect the apprehension we make of a knife : I finde in my understanding that it is a thing so long, so broad, so sharp, so heavy, of such a colour, so moulded, so tempered, &c. as is fit to cut withal. In this total apprehension of a *being* is the most simple and basis of all the rest.

apprehension; I discover three kinds of particular apprehensions, every one more simple and refined than the other. The highest of them, and the foundation upon which the others are built, is the notion of *being*: which is of so high, and of so abstracted a nature, that we cannot retrieve words to express in what manner we conceive it; but are fain to content our selves with the outward sound of a word, by which, without describing our own, we stir up the like conception in another: and that is the word *is*; by which we intimate the *being* of the thing we apprehend. And this notion can be in our mind, without inferring any other; and therefore is the simplest of all others: which of necessity, must imply it, and cannot be without it, although it can be without them.

Our next apprehension is of that which hath *being*: and is expressed by the word *thing*. This is not so simple as the former, for it is composed of it, and of what receiveth it; of *being*, and of *what hath being*: yet it is much simpler than the next degree of apprehensions, which is caused in our mind by the great variety of things, that come thither through our senses; and can be conceived without any of them, though none of them can without it; for I can have in me the notion of *a thing*, abstracting from all accidents whatsoever; as of magnitude, of figure, of colour, of resemblance, or the like: but I cannot conceive it to be long, or sharp, or blew, &c. without allowing it first to be *somewhat* or *something*, that is in such sort affected: so that the apprehension of *a thing*, or of that which *hath being*, is the Basis of all our other subsequent apprehensions; as the apprehension of *being*, is the basis of the apprehension of *a thing*: for had it not *being*, it were not a *thing*; and were it not a *thing*, it could not be said to be a *long thing* or a *sharp thing*; nor indeed that it were *long* or *sharp*; for to be so, doth include *being*; and *what hath being*, is a *thing*. And thus we may observe, how the bulk of our apprehensions is composed of something adventitious, and of something formerly within us, which is of a very different nature from all the others; and yet so fitted and necessary to them, that none of them can be without it, although it not onely can be, but is best conceived without relation to any of them.

We shall easily discern, of how different a strain this conception of *being*, is from all others, that enter by our senses, (as from two things.

the conceptions of colours, of sounds, and the like) if we but reflect upon that act in us, which maketh it; and then compare it with the others: for we shall find, that all they do consist *in*, or of certain respects betwixt two things; whereas this of *being*, is an absolute and simple conception of it self, without any relation to ought else; and cannot be described or expressed with other words, or by comparing it to any other thing: only we are sure, we understand and know what it is.

But to make this point the clearer, it will not be amiss, to shew more particularly, wherein the other sorts of apprehensions are different from this of *being*; and how they consist in certain respects between different things, and are known onely by those respects: whereas this known onely in it self; abstracting from all other things whatsoever. An example will do it best: when I apprehend the *whiteness* in the wall, I may consider how that white, is a thing which maketh such an impression upon my fantasie; and so accordingly, I know or express the nature of *white*, by a respect or proportion of the wall; to work upon my fantasie. In like manner, if we take a notion that ariseth out of what entrench immediately by our senses, (for by joyning such also to the notion of *being*, we make ordinary apprehensions) we shall find the same nature: as when I consider how this white wall, is like to another white wall, the apprehension of *likeness* that I have in my mind, is nothing else, but a notion arising out of the impression, which both those walls together, do make upon my fantasie; so that, this apprehension is as the former, a certain kind of respect or proportion of the two walls to my imagination: not as they make their impressions immediately upon it, but as another notion ariseth, out of comparing the severall impressions, which those two white walls made in it.

7. Let us proceed a little farther, and examine what kind of thing that is, which we call *respect* or *proportion*, and where it resideth. We shall find, that there is a very great difference, between what it is in it self, or in its own essence, and what it is in the things that are respective: for in them, it is nothing else but the things, being plainly and bluntly what they are really in themselves: as for example, two white walls to be like, is in them nothing else, but each of them to be white: and two quantities to be half and whole, is in them nothing else, but each quantity to be just what it is.

Respect or relation hath not really any formal being, but only in the apprehension of man.

is. But a *respect* in its own nature, is a kind of tye, comparison, tending, or order, of one of those things to another; and its no where to be found in its formal subsistence, but in the apprehension of man: and therefore it cannot be described by any similitude, nor be expressed by any means, but (like *being*) by the sound of a word, which we are agreed upon to stir up in us such a notion; for in the things, it is not such a thing as our notion of it is: (which notion is that, which we use to express by Propositions and conjunctions, and which *Aristotle* & Logicians express in common, by the word *προς*, or *ad*) and therefore there is nothing out of us, to paint it by: as I could do *white*, or *square*, or *round*, or the like; because these have a being in the things that are white, or square, &c. and consequently they may be expressed by others of the like nature: but the *likeness* that one white hath to another, or the *respect* that either of them hath to mans imagination, is only the Man; who by comparing them, giveth birth to the nature and Being of *respect*.

Out of this discourse, we may collect two singularities of man; which will much import us, to take particular notice of: the one is, that *being* or a *thing* (the formal notion of which is merely *being*) is the proper affection of man; for every particular thing is in him, by being (as I may say) grafted upon the stock of existence or of *being*: and accordingly we see, that whatsoever we speak of, we say is *something*: and whatsoever we conceive, we give it the nature of a *thing*; as when we have said, the wall is white, we frame *whiteness* as a *thing*: so did we immediately before speaking of *respect*, we took *respect* as it were a *thing*, and enquired *where* it is: so that it is evident, that all the negotiation of our understanding, tradeth in all that is apprehended by it, as if they were *things*.

The other singularity we may observe in man is, that he is a comparing power; for all his particular knowledges, are nothing else but *respects* or *comparisons* between particular things: for example, for a man to know heat, or cold, &c. is to know, what effects fire or water, &c. can work upon such or such bodies.

Out of the first of these properties it followeth, that what affects a man, or maketh impression upon his understanding, doth not thereby lose its own peculiar nature, nor is it modified to the recipient; the contrary of which, we see happeneth per-

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That existence or being is the proper affection of man: and that mans soul is a comparing power.

9.

A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.

petually in bodies : observe the sustenance we take ; which that it may be once part of our body, is first changed into a substance like our body, and ceaseth being what it was : when water or any liquid body is received into a vessel, it loseth its own figure, and putteth on the figure of the vessel it is in : if heat entereth into a body that is already hot, that heat becometh thereby more heat ; if into a cold body, it is converted into warmth ; & in like manner, all other corporeal things are accommodated to the qualities of the recipient ; and in it, they lose their own proper terms and consistences : but what cometh into the understanding of a man, is in such sort received by him, or joyned to him, that it still retaineth its own proper limitations & particular nature ; notwithstanding the assumption of it unto him : for *being* is joyned to every thing there, since (as we have said) it is by *being* that any thing cometh thither : and consequently this stock of *being*, maketh every graft that is inoculated into it, be what of its own nature it is ; for *being* joyned to another notion, doth not change that notion, but maketh it be what it was before ; thence if it should be changed, *being* were not added to it : as for example, add *being* to the notion of *knife*, and it maketh a *knife*, or that notion, to be a *knife* : and if after the addition, it doth not remain a *knife*, it was not *being*, that was added to a *knife*.

10.
A multitude of things may be united in mans understanding without being mingled or confounded together.

Out of the later of the singularities proper to man, it followeth, that multitude of things may be united in him, without suffering any confusion among themselves ; but every one of them, will remain with its proprieties, and distinct limitations : for so of necessity it must be, when that which uniteth them to him, is the comparing of them to something besides themselves : which work could not be performed, unlesse what is to be compared, do retain exactly its own nature, whereby the comparison may be made : no more than one can weigh two quantities one against another, unlesse he keep asunder what is in each scale, and keep all other weights from mingling with them : and accordingly we see that we cannot compare black to white, or a horse to an ox, unlesse we take together, the properties by which black differeth from white, or an ox from a horse : and consequently, they must remain unmingled and without confusion, precisely what in themselves they are, and be different in the sight of the comparer.

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But indeed, if we look well into the matter, we shall find, that setting aside the notion of *existence* or of *being*, all our other notions are noshing else, but *comparisons* and *respects*: and that by the mediation of *respects*, the natures of all things are in us: and that by the varying of them, we multiply our notions, which in their first division, that reduceth their several kinds into general heads, do increase into the ten famous Tribes, that Logicians call *predicaments*: and they do comprehend under them, all the particular notions that man hath, or can have, according to the course of knowledge in this life. Of which *predicaments* the seven last are so manifestly *respective*, that all men acknowledge them to be so. *Substance* we have already shewed to have a respect unto *being*. *Quantity* we proved in the first Chapter of the former Treatise of the nature and of the operation of Bodies, to consist in a respect unto parts. *Quality* is divided into four branches: whereof *Power* is clearly a respect to that over which it hath power, or from which it may suffer. *Habit* is a respect to the substance wherein it is; as being the property by which it is well or ill, conveniently or inconveniently affected, in regard of its own nature; as you may observe in health, or sickness, or the like. The *passible qualities* are those which we have explicated, in discoursing of the Elements and of Mixts; and whose natures we have there shewed do consist in respects of acting, or suffering. *Figure* or *shape* (which is the last branch of the division of the Predicament of *Quality*) is nothing else, but a certain disposition of one part of a body to another. And so you see, how all the ten *predicaments* do consist purely in diversity of *respects*: and by consequence, all our conceits and notions (excepting that of *being*, which is the stock, upon which all the rest are grafted) are nothing else, but various respects; since all of them whatsoever, are comprised under those general heads. Concerning which, we shall not need to dilate our selves any farther; seeing they are to be found in *Aristotle*, and in his Commentators, largely discoursed of.

In the next place, let us observe, how our understanding be-
 haveth it self, in considering and in apprehending these respects. We have already declared, that the variety of our notions doth arise out of the respects which divers things have to one another: hence will follow, that of the same thing, we may have various notions

II.

Of abstracted
and concrete
terms.

notions : for comparing it to different things, we shall meet with different respects between them ; and consequently, we shall consider the same thing, under different notions : as when we consider an apple, under the notions of greenness, of sweetness, of roundness, of mellowness, &c. in such sort, as we have amply declared in the first Treatise, and therefore need not here enlarge our selves any farther upon this particular. Now these notions are so absolutely severed one from another, and every one of them hath such a completeness within it self, that we may use any one of them, without meddling at all with any of the others. And this we do two several waies : the one, when our manner of apprehension determineth us to one precise notion, which is so summed up within it self, as it not onely abstracteth from all other notions, but also quite excludeth them, and admitteth no society with them. The other way is, when we consider a thing under a determinate notion, yet we do it in such a manner, that although we abstract from all other notions, nevertheless we do so, rather by neglecting, than by excluding them : and even in the manner of our expression of it, we insinuate that there are other notions (without specifying what) belonging unto it.

Of the first kinde of notions, are whiteness, weight, heat, and such like, (whose names are called *abstracted termes*) which although they arise out of our comparing of the things that are white, heavie, hot, &c. to our fantasie, or to other things ; yet these notions are so precise, and shut up within themselves, that they absolutely exclude all others, (as of long, short, square, rough, sharp, or whatsoever else) which may in the things accompany the whiteness, weight, heat, &c. that our consideration is then busied only withall. Of the second kind of abstracted notions, are white, heavie, hot, &c. (whose names, expressing them, are called *concrete termes* :) which although they cause in us no other apprehensions than of whiteness, of weight, of heat, &c. yet they are not so rigorously paled in, as the others are, from admitting society with any besides ; but do imply tacitely, that the thing which is white, heavie, hot, &c. hath besides that, some other consideration belonging unto it (whatsoever it be) which is not expressed.

Now in this latter abstraction, it happeneth sometimes, that the notion expressed, hath but an accidental connexion with
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the other notions, that are in the thing unexpressed: as for example, it is merely accidental to the white wall as it is *white*, to be high or low, of stone, of plaister, or the like. But otherwhiles, the expressed notion is so essential to the concealed ones, that they cannot be without it: as when we apprehend a cloven foot, although this apprehension do abstract from all other notions besides *clovenfootedness* (if so I may say) yet, (as above we have declared) it is in such a manner, that it implieth other considerations, not yet expressed, in that cloven foot: among which, some may be of that nature, that they cannot have a Being without presupposing clovenfootedness; but others may be merely accidental to that notion: as (for instance sake) let one be, *that the foot is cloven into three parts*; and let another be, *that it is black or hairy*; of these, this latter notion of *black or hairy*, is of the first kinde of abstractions, which we said had but an accidental connexion with that which comprehended them without expressing them: for other things besides the cloven foot, may be black or hairy; in such sort as height or lowness, to be of stone or of plaster, may belong unto other structures besides the white wall: but to be *cloven footed into three parts*, doth so necessarily depend of being cloven footed in general, (which implieth this particular) and so directly includeth it, as it cannot subsist without *clovenfootedness*: for though we may conceive a foot to be cloven, without determining in our apprehension, into how many toes it is cloven; yet we cannot conceive it to have three, four, or five toes, without apprehending it to be cloven: so that in such like apprehensions, the notion which is expressed, is so essential to the notion that is concealed and added unto it, as the concealed one cannot be conceived without the expressed one; and whensoever it is mentioned, the other is necessarily also brought in, and affirmed with it.

Now, some of these later kinds of notions, (in which what is expressed is essential to what is concealed) may be of such a nature as to be capable of receiving the addition of sundry other notions, so repugnant unto one another, that they cannot agree together in one subject; and yet that general notion, without determining any of the others, be indifferent to the contrary additions that include it, and belong as much to any one, as to any other of them:

12.

Of universal notions.

them : and so consequently, whatsoever may be affirmed, and is true, of the primary notion, may as well be affirmed, and is as true, of the several particulars, arising out of the repugnant additions. Such a notion, Logicians term an *universal* one : that is, one that reacheth indifferently and equally to all the particulars comprised under it. As for example : to the notion of a living creature, may be added the notions of *reasonable* and *unreasonable* : which first notion, when it is barely expressed, it determineth no one of the two secondary notions, more than it doth the other : but is alike indifferent to either ; and whatsoever belongeth to a living creature, belongeth entirely both to a man and to a beast : yet no one thing, can be both *reasonable* and *unreasonable*. In like manner when I say, *a man is a discursive creature* ; under this word *man*, there lieth a notion, by which may be signified any particular man, as *Thomas, John, William, &c.* though of it self, it determine no one man whatsoever : and consequently, every one of these particular men, must be allowed to be a discursive creature ; because the being such, belongeth unto the notion of *man*, and that notion unto all the particulars of *Thomas, John, William, &c.* and yet no particular man can be both *Thomas* and *John*, or *John* and *William, &c.*

In this kind of notion, we may observe yet one propriety more : which is, that of it self, and in its common term, it doth not cause ones thought to range unto several objects ; nor doth imply that there are many particulars comprised under it : yet if there be never so many, that conceit will fit them every one ; and if there be but one, still it will be no less accommodated to that one. As for example : He that maketh a right apprehension of a *sun*, doth not by that conception determine, whether there be many suns or but one : and if every one of the stars (which we call fixed) be suns to other earths, it fiteth them all ; and if there be no other sun, than that which shineth to us, it is satisfied and taken up with that : so, likewise, before the production of *Eve*, the notion of a *man* was as fully taken up by *Adam* alone, as it is now by his numerous progeny that filleth the world : nor doth our understanding, when that term is pronounced, consider (out of the force of the terme) whether there be many men, or only one.

13.
Of apprehending a multitude under one notion.

Another propriety in mans apprehension not much unlike to

to this, is, that he is able to comprise a multitude in one indivisible notion, and yet, that notion expresse the multiplicity of what it containeth : as we see in numbers, where the indivisible conception of *ten, a hundred, a thousand, &c.* doth plainly expresse the subject to be many ; and yet that notion of the number bindeth them up (as I may say) into one bundle, that in it self admitteth no division, nor will permit that the least part be taken from it ; for if it be, the whole bundle is destroyed and vanisheth : as when I take *ten*, if one be diminished from it, it is no longer *ten*, but *nine*. It fareth in like manner with the conceptions we frame of *All*, and *Every one*, as it doth with numbers ; for if but one be deficient, it is but a part, and not *all*, or *every one* : so that these notions do invisibly terminate a multitude. And like to this notion, is the name or term *whole*, in respect of things which as yet have not division, but are capable of being divided ; for it is so rigorous, that if the least atome or thought be wanting, it is no longer the *whole*, but only a part.

And this is as much as at present appeareth unto me needful to be said, concerning single apprehensions : unlesse I be permitted to adde for a conclusion, this little note, (which peradventure might have been more properly set down in another place, where we discoursed of *Being*, but that it occurred not then to me) that apprehension being rooted in the nature of *Being*, the power of it spreadeth it self as far as the extent of *Being* : and consequently reacheth to all things whatsoever ; for whatsoever is a *thing*, hath *Being* ; and that unto which *Being* doth not reach is nothing. Nay, it is not limited there, but graspeth even at *nothing*, and aimeth to make a notion of it, and planteth its generation, by multiplying it self by negations of whatsoever is. Hence we have the notions of deafness, of dumbness, of blindness, of lameness, of baldness, of death, of sin, and of all evils whatsoever, by the want of such goods, as are sensible unto us.

14.

The power of the understanding reacheth as far as the extent of being.

THE

THE SECOND CHAPTER.

Of Thinking and Knowing.

I.
How a judgement is made by the understanding.

HAVING thus declared the nature of single apprehensions, the method we have prescribed our selves, requireth that we examine in the next place, what effect the joyning of them together may have; for from thence do spring *Enunciations* or *Judgements*; which are in the next rank after simple apprehensions, and are the materials whereof *discourses* are immediately framed: as when of the two apprehensions of *knife* and of *sharp*, we may make this enunciation, *the knife is sharp*. In this enquiry the first thing that occurreth unto us, is to consider, in what manner two differing simple apprehensions, do become joyned to one another: and we shall finde, that they are not tyed together like several distinct things in one bundle, or like stones in a heap, where all that are comprised under one multitude, are yet circumscribed within their own limits, and thereby are wholly distinguished from each other; but that they are as it were grafted upon one stock; which being common to both, giveth the same life to both: and so becomming one with each of them, maketh them be one and the same thing between themselves. And this is the notion of *Being* or *Existence*, in the subject we speak of: which (as we have already shewed) is the Basis and foundation of all other apprehensions; and by being common and indifferent to all, is the fittest glew to unite those that are capable of such conjunction: and accordingly we see, that most of our speech runneth upon this strain, that *this is that*, or *doth that*, (which is as much to say as *is doing that*) that *Socrates is a man*, or that *Socrates runneth*, (which signifieth, *is running*) and the like: and since our speech proceedeth from the conceptions of our mind; it is clear, that as the words which expresse *Being* or *Existence*, do joyn together the other words that we use, (or at least, the greatest part of them) so likewise in our mind the apprehension of *Being*, is the glew that joyneth our apprehensions, corresponding to our words.

All which will appear to be said with great reason, if we reflect upon it; for when diverse apprehensions may be thus joyned together, it is indeed, that one and the same thing affecting us several

veral waies and under different considerations; those indifferent expressions do beget different apprehensions in us: and so, till we examine the matter, every one of them seemeth to be a different thing: but when we trace these streams up to the fountain-head, we discern that all of them do belong to one and the same thing; and that by being in that thing, they are among themselves the very same thing, however they affect us variously; and therefore may truly be said to be one, as indeed they are: and consequently, nothing is more fit to joyn together in our minde those different apprehensions, than the apprehension of *Being*; which maketh us apprehend as one thing, those notions which really, and in the thing it self, are but one, as we have often touched, both in the former Treatise, and lately in this: for this is the way to joyn things in the minde intelligently, and according to the proper nature of the minde; which receiving impressions from things existent, ought to consider those impressions as they flow from the very things, and not as they are in the minde it self; and by mediation of those impressions, must take a survey of the things themselves; and not stay at the intellectual impressions they make in her: and consequently, must apprehend those things to be one in themselves, (although in us they be not so) according to the course of our original and legitimate apprehensions of things; which is, as they are existent; that is, as they are in their own nature, and in themselves; and not according to the discourses and secondary apprehensions we make of the images we finde of them in our minde. And thus things are rightly joyned by apprehension; without caution in which particular, we shall run into great errors in our discourse: for if we be not very careful herein, we are apt to mistake the use of the impressions we receive from things, and to ground our judgments concerning them, according to what we finde of them in our minde, and not according to what they are in themselves: which two severall Considerations, have quite different faces; although (it is true) those impressions are made by the things, and are the only means by which we may rightly judge of them: provided, that we consider them as they are in the things, and not as they are in us.

Now this conjunction of apprehensions, by the mediation and the glew of *Being*, is the most natural and fitting, not only in regard

regard of the things, but even in regard of us: for (as we have already shewed) it is of all others the most common and universal, the most simple or uncomposed, and the most natural and deepest rooted in man: out of all which, it is evident, that this union of apprehensions by the means of *Being*, is in truth an Identification of them: for Unity being a negation of multiplicity, it followeth, that what is one, is the same: and this identification is truly and naturally expressed by saying, that *the one is the other*.

3.
How the notions of a substantive and an adjective, are united in the soul, by the common stock of being.

But insisting a little further upon this consideration, how different apprehensions become joyned and united together, by the notion of *Being*; we may observe that this happeneth, not only to two single ones, but to more; according as more then two, may belong unto one thing: and it may so fall out, that more then one, be on either side the common ligament. Thus when we say, *A Man is a discursive creature*; or *a Rational soul, is an immortal substance*, the two apprehensions, of *discursive*, and of *creature*, are joyned together in a third of *Man*, by the tie of one *Being*: and the two apprehensions of *Immortal*, and of *Substance*, are united to the two others of *Rational* and of *Soul*, likewise by the ligament of one single *Being*. Evident it is then, that the extremes are united by one *Being*: but how the two apprehensions that are ranked together on the same side of the ligament (as in our former examples, the apprehensions of *discursive* and of *creature*, of *Rational* and of *Soul*, of *Immortal* and of *Substance*) are between themselves joyned to one another, is not so easie to expresse. It is clear, that it is not done by meer conglobation; for we may observe, that they do belong, or are apprehended to belong, unto the same thing; and the very words that expresse them, do intimate so much, by one of them being an adjective; which sheweth, they are not two things; for if they were, they would require two substantives to describe them: and consequently it followeth that one of them must needs appertain to the other: and so both of them make but one thing.

And there is no doubt, but in the inward apprehension, there is a variety correspondent to the variety of words which expresse it; since all variety of words that is made by intention, resulteth out of some such variety of apprehensions. Therefore, since the words do import, that the things have a dependance the one of the

the other, we cannot doubt, but that our apprehensions have so too: which will be conceived best, by looking into the act of our minde, when it frameth such variety of apprehensions belonging to one thing, correspondent to the variety in words of an *adjective* glewed unto his *substantive*; and attending heedfully to what we mean, when we speak so. The Hebrews do expresse this union, or comprising of two different apprehensions under one notion, by putting in the genitive case, the word which expresseth one of them, (much like the Rule in Lilly's Grammar, that when two substantives come together, if they belong to the same thing, the one is put in the genitive case.) As when in the Scripture we meet with these words, *the judge of unjustice, the spence of wickedness, the man of sin, or of death*; which in our phrase of speaking, do signifie an unjust Judge, a wicked spence, and a sinfull or dead man. In which it is evident, that as well the manner of understandings as of speaking, taketh each paire of these notions to belong unto one thing; that is, to have both of them, one and the same *existence*, although there intervene not the formal expression of their being one. Thus we see, how one *being* serveth two different waies to joyn and unite severall apprehensions: and if we will examine all the negotiations of our understanding, we shall hardly finde any notions so far distant, but may be brought together, either by the one of these waies, or by the other.

But this composition and joyning of severall apprehensions by the glew of *being*, is not sufficient to make us deem a thing to be really such, as their union painteth in the mind, or as the words so tied together do expresse in speech. Well may it cause us to think of the thing; but to think, or to deem it such an one, (which word of *deeming* we shall be obliged henceforward to use frequently, because the word *thinking* is subject to equivocation) requireth the addition of something more, than barely this composition of apprehensions; which unless they be kept straight by some level, may as well swerve from the subject, as make a true picture of it. Here then we are to examine, what it is that maketh us think any thing to be such as we apprehend it: this we are sure of, that when we do so, our actions which proceed upon reason, and which have relation to that thing, are governed and steered in every circumstance, just as the thing were truly so:

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4.

That a settled judgement becometh a part of our soul.

as for example, if a man do really deem the weather to be cold, or that his body is distempered, he putteth on warmer clothes, or taketh physick; although peradventure he is mistaken in both: for his deeming them to be so, maketh him demean himself in such sort, as if really they were so. It is then evident, that by such thinking or deeming, the nature conceived, is made an active principle in us: unto which if we add, that all the knowledge we have of our soul, is no more, but that it is an *active force* in us, it seemeth, that a thing, by having apprehensions made of it in our mind, and by being really thought to be agreeable to such apprehensions, becometh (as it were) a part or affection of our soul, and one thing with it. And this peradventure is the cause, why an understanding man cannot easily leave an opinion once deeply rooted in him; but doth wrestle and strive against all arguments that would force him from it, as if a part of his soul or understanding were to be torn from him: in such manner as a beast will cry and struggle to save his body, from having any of his limbs disjoynted or pulled in pieces.

5.
How the soul
cometh to
deem or settle
a judgement.

But this observing the effect which followeth of our deeming a thing to be thus or so, is not sufficient to inform us, what it is that causeth that deeming. We must therefore take the matter a little higher, and look into its immediate principles: and there we shall finde, that it is the knowing of what we say to be true, and the assurance, that the things are as we deem them, which quieteth our soul, and maketh it consent unto them, and proceed to action upon that consent. Now this knowledge, is the most eminent part of deeming; and of all our acquisitions, is the most inseparable from us: and indeed in rigour, it is absolutely inseparable by direct means; however peradventure by indirect means it may be separated.

Let us then consider how we attaine unto it, and how sometimes we fail in the purchase of it; and what degrees of assurance or of probability there are between it and error. To this intent, we may observe that the greatest assurance, and the most eminent knowledge we can have of any thing, is of such Propositions, as in the Schools are called *Identical*; as if one should say, *John is John*, or *a man is a man*: for the truth of these Propositions is so evident and clear, as it is impossible any man should doubt of them, if he understand what
he

he saith: and if we should meet with one that were not satisfied of the verity of them, we would not go about to prove them to him, but would onely apply our selves to make him reflect upon the words he speaketh, without using any farther industry to gain his assent thereunto; which is a manifest signe, that in such Propositions, the apprehending or understanding them, is the same thing as to know them and to consent unto them: or at the least, that they are so necessarily conjoynd, as the one followeth immediately out of the other, without needing any other causes to promote this effect, more than that a man be disposed, and willing to see the truth: so as we may conclude, that to understand a Proposition which onely carrieth its evidence with it, is to know it. And by the same reason, although the evidence of a Proposition, should not at the first sight be presently obvious unto us, yet with unfolding and explicating of it, we come at length to discern it; then likewise the apprehending of it, is the knowing of it.

We must therefore enquire, what it is that causeth this evidence: and to that purpose, reflecting upon those instances we have given of *Identical Propositions*, we may in them observe, that evidence ariseth out of the plain Identification of the extremes that are affirmed of one another: so that, in what Proposition soever, the Identification of the extremes is plain, the truth of it is evident unto us, and our mind is satisfied and at quiet; as being assured that it knoweth it to be so as the words say it. Now all affirmative Propositions do by the form of them import an Identification of their extremes, (for they all agree in saying, *This is that*) yet they are not all alike in the evidence of their Identification: for in some it sheweth it self plainly, without needing any farther help to discover it; and those are without any more ado knowne of themselves, as such *Identical* sayings, we even now gave for examples: others require a journey somewhat farther about, to shew their identification; which if it be not so hidden, but that it may in the end be discovered and brought to light, as soon as that is done, the knowledge settled by them in the soul, is certain and satisfactory as well as the other: but if it be so obscure, that we cannot display the Identification of it, then our minde suspendeth his assent, and is

unquiet about it, and doubteth of the truth of it: in some Propositions, whiles he searcheth and enquireth after the Identification of their extremes; peradventure he discerneth, that it is impossible there should be any between them; and then on the other side, he is satisfied of the falsity of them: for if a Proposition be affirmative, it must necessarily be a false one, if there be no Identification between the extremes of it.

By this Discourse, we have found two sorts of Propositions, which beget knowledge in us. The one, where the Identification of the extremes, is of it self so manifest, that when they are but explicated, it needeth no farther proofs. The other, where though in truth they be identified, yet the Identification appeareth not so clear, but that some discourse is required to satisfy the understanding therein. Of the first kind, are such Propositions, as do make one of the extremes the definition of the other whereof it is affirmed: as when we say, *a man is a reasonable creature*; which is so evident, if we understand what is meant by a *man*, and what by a *reasonable creature*, as it needeth no farther proof to make us know it: and knowledge is begotten in us, not onely by a perfect Identification of the extremes, but as well by an imperfect one: as when what is said of another, is but part of its definition; for example, if one should say, *a man is a creature*, no body that knoweth him to be a rational creature, (which is his compleat definition) could doubt of his being a creature; because that the being a *creature*, is partly identified, to being a *rational creature*. In like manner, this obvious evidence of *Identification*, appeareth as well where a compleat division of a thing is affirmed of the other extreme, as where the affirmation is made by the total or partial definition of it: as when we say, number is even or odd: an enuntiation is true or false, and the like: where, because what is said, compriseth the differences of the thing whereof it is said, it is plain that of them must needs be that whereof we speak.

Peradventure some may expect, that we should give *Identical Propositions* (among others) for examples of this plain evidence: but because they bring no acquisition of new knowledge unto the soul, (the doing of which, and the reflecting upon the manner, is the scope of this Chapter) I let them pass without

out any farther mention, upon this occasion having produced them once before, only to shew by an undeniable example, what it is that maketh our soul consent unto an enunciation, and how knowledge is begotten in her, that we might afterwards apply the force of it to other Propositions.

Let us therefore proceed to the second sort of Propositions, which require some discourse, to prove the Identification of their extremes. Now the scope of such discourse is, by comparing them unto some other third thing, to shew their Identification between themselves; for it sheweth, that each of them apart is identified with that new subject it bringeth in: and then our understanding is satisfied of their identity, and our soul is secure of that knowledge it thus acquireth, as well as it is of that which resulteth out of those Propositions, which bear their evidence in their first aspect.

This negotiation of the understanding to discover the truth of Propositions, when it is somewhat hidden, (which we call *discourse*) as it is one of the chiefest and noblest actions of the soul, so doth it challenge a very heedful inspection into it: and therefore we will allow it a peculiar Chapter by it self, to explicate the nature and particularities of it. But this little we now have said concerning it, is sufficient for this place; where all we aim at is to prove (and I conceive we have done it very fully) that when *Identity* between two or more things, presenteth it self to our understanding, it maketh and forceth knowledge in our soul.

Whence it is manifest, that the same power or soul, which in a single apprehension is possessed with the *Entity* or *Unity* of it, is that very power or soul, which applyed to an *Enunciation*, knoweth or deemeth; since *knowing* is nothing else, but the apprehending of manifest Identity in the extremes of a Proposition, or an effect immediately consequent out of it, in the soul that applyeth it self to apprehend that Identity. Which apprehension is made, either by the force of the extremes, applyed immediately to one another, or else by the application of them to some other thing: which peradventure may require yet a further application unto new apprehensions; to make the Identity between the first extremes appear evidently.

Now, as when *Identity* truly appeareth, it maketh evidence to our understanding, and begetteth assured knowledge in our

6.
How opinion
is begotten in
the understand-
ing.

soul; so, when there is only an apparent Identity, but not a real one, it happeneth that the understanding is quieted without evidence; and our soul is fraught with a wrong or slight belief, instead of certain knowledge: As for example, it is for the most part true, that what wise men affirme, is so as they say; but because wise men are but men (and consequently not infallible) it may happen that in some one thing, the wisest men that are may misse, though in most and generally speaking, they hit right. Now if any body in a particular occasion, should) without examining the matter) take this proposition rigorously and peremptory, by *that what wise men affirme is true*; and should thereupon subsume with evidence, *that wise men say such a particular thing*, and should thereupon proceed to believe it; in this case he may be deceived, because the first proposition is not verily, but only seemingly evident.

And this is the manner how that kinde of deeming, which is either opposed, or inferiour to knowledge, is bred in us: to wit, when either through temerity, in such cases where we may, and it is just we should examine all particulars so carefully, that no equivocation or mistake in any part of them, be admitted to passe upon us for a truth, and yet we do not: or else, through the limitedness and imperfection of our nature, when the minuteness and variety of petty circumstances in a business is such, as we cannot enter into an exact examination of all that belongeth to that matter, (for if we should exactly discusse every slight particular, we should never get through any thing of moment) we settle our understanding upon grounds that are not sufficient to move and determine it. Now in some of these cases, (and particularly in the latter) it may haappen, that the understanding it self is aware, that it neither hath discovered, nor can discover evidence enough, to settle its assent with absolute assurance: and then it judgeth the belief it affordeth unto such a proposition, to be but probable; and instead of knowledge, hath but *opinion* concerning it. Which *opinion* appeareth to it more or lesse probable, according as the motives it relyeth on, are stronger or weaker.

7.
How faith is
begotten in the
understanding. There remaineth yet another kinde of deeming for us to speak of; which though it ever fail of evidence, yet sometimes it is better then opinion, for sometimes it bringeth certitude with it. This we call *Faith*; and it is bred in this sort: when we meet with

with a man, who knoweth something which we do not, if with-
all we be perswaded that he doth not, nor will not tell a lye; we
then believe what he saith of that thing to be true: now accord-
ing to the perswasion we have of his knowledge and veracity,
our belief is strong, or mingled with doubt: so that if we have
absolute assurance and certainty, that he knoweth the truth and
will not lye, then we may be assured, that the faith which we
yield to what he saith, is certain as well as evident knowledge
is certain, and admitteth no comparison with opinion, be it never
so probable: but so it may happen, that we may be certainly as-
sured that a man doth know the truth of what he speaketh of, &
that he will not lye in reporting it to us: for seeing no man is
wicked without a cause; and that to tell a lye in a serious matter,
is a great wickednesse; if once we come to be certain that he hath
no cause, (as it may fall out we may) then it followeth, that we
are assured of the thing which he reporteth to us.

Yet still such faith falleth short of the evidence of knowledge
in this regard, that its evidence sticketh one degree on this side the
thing it self: and at the push, in such a case we see but with ano-
thers eyes; and consequently, if any opposition do arise against
our thought thereabout, it is dot the beams, and the light of the
thing it self, which strengthen us against such opposition, but the
goodness of the party upon whom we rely.

Before I go any farther, I must needs remember one thing,
that our Masters teach us: which is, that truth and falsehood are
first found in sayings or *Enuntiations*; and that although single
apprehensions are in our minde before these judgements, yet are
they not true or false themselves, nor is the understanding so by
them. To comprehend the reason of this maxime, let us consider
what truth and falsehood are: surely truth is nothing else, but the
conformity of our understanding, with the things that make im-
pression upon it: and consequently, falsehood is a disagreeing
between our minde and those things: if the existence which the
things have in us, be agreeable to the Existence they have in
themselves; then our understanding is true; otherwise it is false.
Now the natural perfection of our Soul or understanding, is to
be fraught with the rest of the whole world, that is to have the
knowledge of all things that are; the knowledge of their essen-
ces, of their natures, of their proprieties, of their operations, and

2.

why truth is
the perfection
of a reasonable
soul: and why
it is not found
in simple ap-
prehensions as
well as in E-
nuntiations.

of whatsoever else belongeth to them all in general, and to every one of them in particular : but our soul cannot be stored or fraught with any thing, by other means then by her assent or deeming : whereupon it followeth, that she cannot have her perfection, until her deemings or judgements be perfect ; which is, that they be agreeable unto the things in the world : when they are so, then are they true. And this is the reason why truth is the aim, and perfection of the soul. Now then, truth residing only in the assents and judgements of the soul, (which are the traffick whereby she enricheth her self with the rest of the world) and they being framed by her discerning an identity between two things ; which she expresth by affirming one of them of the other : it followeth, that nothing can be true or false, but where there is a composition of two extremes, made by the ones being affirmed of the other ; which is done onely in Enunciations or judgements : whiles single apprehensions assent to nothing, and therefore settle no knowledge in the soul ; and consequently are not capable of verity or falsity, but are like pictures made at fancy, some one of which may happen to be like some Person, but cannot be said to be the picture of him, because it was not drawn from him : so these bare apprehensions, because there is not in the man union of the soul to the outward world, or to the Existence which actuateth its object, therefore they make not the soul to be the image of the things existent : but the judgement, which still taketh a thing existent, or as existent, in the subject of the proposition, draweth its picture from the thing it self : and therefore it maketh the soul to be well or ill painted, in respect of the thing that is true or false.

And this is the reason, why in one sense doubtful propositions, which the understanding (not being yet resolved) maketh inquiringly to inform it self of the truth of them, cannot be said to be true or false ; for all that while, the soul yieldeth no assent unto them, either one way or other ; yet in another sense they may, which is, taking them as subjects that the understanding determineth unto it self to treat of : for there being two extremes in them, and the proposition consisting in this, whether these extremes be identified or no, it followeth, that since one part must of necessity be, such a proposition spoken at random, or written by chance without design, is of necessity either
true

true or false; according as the extremes of it, are or are not one thing.

There occureth no more unto my consideration to be said in this place, concerning the assents and judgements of the minde: unless it be, to explicate in a word or two, the several qualities of them, which are found in several Persons; and to point at the reason why they are called by those names, which they are universally known by. To which purpose we may observe, that judgement or *deeming*, being a quieting of the minde, it followeth that the minde must needs be at disquiet and at unrest, before it commeth to judge: so that we may conclude, that judgement or thinking, is a good attained by a former motion. Now according to the quality of this motion, the judgement or assent, is qualified and denominated. We must therefore consider what belongeth to motion; which when we have done, we shall in judgements finde something proportionable thereunto.

9.

What is a solid judgement, and what a slight one.

We know there is a beginning and an ending in motion; and that there are parts by which it is drawn out in length: all which must be particularly considered, in our comparing of motions unto judgements. Now then, as he that would know precisely the nature of any motion, must not begin his survey of it, after it hath been some time in fluxe; nor must give over his observing it, before it have arrived unto its utmost period; but ought to carry his attention along from its first origine, and passe with it through all its parts, until it ceasing, give him leave to do so too (for otherwise, it may happen that the course of it be differing in those parts he hath not observed, from those that he hath, and accordingly, the picture he shall make of it by that imperfect scantling, will prove an erroneous one;) so in like manner, when a man is to make a judgement of any matter in question, to give a good account of it, he must begin at the root, and follow successively all the branches it divideth it self into, and drive every one of them to their utmost extremity and period: and according as in judging he behaveth himself well or ill, in the several circumstances that are proportionable to the beginning, ending, and parts of motion; so his judgement is qualified with the names of several virtues agreeing thereunto, or of their opposite defects.

If he begin his considerations very low, and from the very bottom and root of the affair, which is from the first and all comprehending principles of the question, and proceed on orderly taking all before him; his judgement is accounted *deep, profound, and solid*: for he that casteth so far, as to leave behinde him no part of the matter he is inquiring about, & then driveth his course steadily and smoothly forwards, without any leaps over rugged passages, or interruptions, or loose breaches; must of necessity make a well grounded judgement; and such an one, as cannot easily be overthrown, or be easily removed from it.

And this is indeed the full reason, of what a little above we only glanced at: namely, why understanding men are usually accounted obstinate in their tenets, and are hard to be removed from their opinions once settled in their mindes: for when other men oppose them, they urge nothing (for the most part) against these judicious mens resolutions or beliefs, but what they have already thoroughly foreseen: but these on the other side, do see a great deal, that their opposers reach not unto; so that notwithstanding all such opposition, they continue still unshaken in their judgements: for which, the others which see not as much as they do thinke them obstinate, and not led by reason, because they follow not that short reason, beyond which themselves cannot reach.

The contrary vice to this, is called a *slight judgement*: and consisteth herein, that a man out of a few, and an insufficient number of circumstances, resolveth the whole case: which temerity and short sightedness of judgement, is significantly taxed in our English proverb, that *a fools bolt is soon shot*.

10. Thus much for the beginning of a judgement: the next consideration may be concerning the end of it; in regard whereof, if it reach to the utmost extent and period of what is considerable in a hard question proposed, it gaineth the title of *sharp*, or of *subtile*, and *acute*; for the hardnesse of the matter that perplexeth ones judgement, consisteth in the involution of things, which looked upon ingrosse, do seem to have no distinction or opposition among themselves; and yet are in truth of very different and contrary natures. Now a good judgement divideth and cutteth through them, and alloteth unto every particular thing its proper limits and bounds: wherefore, as in corporeal substan-

What is an acute judgement and what a subtile one.

ces, the vertue of dividing is sharpness and edge, by translation from thence, such a judgement as pierceth neatly and smartly between contradictories that lie close together, is called *sharp* and *acute*. In like manner, *subtility* is a vertue, whereby a liquor or other body searcheth every little hole and part of what it worketh upon, till it get through it; and from thence, it is used in judgements to signifie the same: whose opposite vice is called *dulness*.

In the last place we are to examine, what proportion a judgement holdeth with the parts of motion: in these, two things are to be considered, namely the quantity or multitude of those parts, and the order of them. As for the quantity in a motion, it belongeth either to long or short, or to quick and slow: now, where the beginning and ending are already known and determined, and consequently where the length is determined, and dependeth not at all of the judge to alter it, (for he must take it as the matter giveth it) there a judgement can acquire no denomination of perfection or deficiency, from length or from shortness; for they belong originally to the matter of the judgement; and the judgement must accordingly fit it self to that; and therefore is liable neither to commendations nor to reproach, for being long or short: it remaineth then, that the vertue in *judging* answerable to the quantity of motion, must consist in quickness and celerity; and the contrary vice, in slowness and heaviness.

As for order in the several parts of motion, we know that if they be well ordered, they are distinct and easily discernable. Which vertue, in our subject, is called *clearness of judgement*; as the contrary vice is *confusion*.

II.

In what consisteth quickness and clearness of judgement: and their opposite vices.

THE

THE THIRD CHAPTER.

Of Discoursing.

1. **I**N the last Chapter we have shewed, how two apprehensions
 How discourse
 made. joyned together do make a judgement : now in this our
 first employment will be, to shew how three of these
 Thoughts or Judgements, well chosen and duely ordered, do
 compose the first and most simple of perfect discourses ; which
 Logicians call a Syllogism : whose end and effect is to gain the
 knowledge of something, before hidden and unknown. The
 means whereby this is compass'd, is thus. By the two first
 judgements, we joyn the extremes of the proposition we desire
 to know, unto some third thing ; and then, by seeing that they
 both are one third thing, and that one can be but one, we come
 to discern, that truly one of them is the other ; which before we
 saw not : so that, the *identity*, which first made an identical pro-
 position be known and agreed unto ; and afterwards caused
 the like assent to be yielded unto those maxims, whose identifi-
 cation presently shewed it self, now by a little circuit and
 bringing in of a third term, maketh the two first (whose identi-
 fication was hidden and obscure, whiles we looked upon the
 terms themselves) appear to be in very truth but one thing.

2. **T**he various mingling and disposing of these three terms in
 Of the figures
 and moods of
 Syllogisms. the two first propositions, begetteth a variety in the syllogisms
 that are composed of them : and it consisteth in this, that the as-
 sumed term unto which the other two are interchangeably joy-
 ned, is either said of them, or they are said of it : and from hence
 spring three different kinds of syllogisms ; for either the assumed
 or middle term, is said of both the other two ; or both they are
 said of it ; or it is said of one of them, and the other is said of it :
 neither is there any deeper mystery then this, in the three figures,
 our great Clerks talk so much of : which being brought into
 rules, to help our memory in the ready use of this transposition
 of the termes ; if we spin our thoughts upon them into over
 small threads, and thereof weave too intricate webs (mean-
 while not reflecting upon the solid ground within our selves,
 whereon these rules are built, nor considering the true end why ;)
 we

we may spend our time in trivial and uselesse subtilities : and at length, confound and misapply the right use of our natural discourse, with a multitude of precepts drawn from artificial Logick.

But to return to our matter in hand; under this primary three-fold variety, is another of greater extent, growing out of the divers composition of the three terms, as they are qualified by *affirmation* or *negation*, and by *universality* or *particularity*: for that unity, which the two terms, whose identification is enquired after, must have, by being joyned with the third, becometh much varied by such divers application : and from hence shooteth up that multitude of kindes of syllogisms, which our Logicians call Moods. All which I have thus particularly expressed, to the end we may observe how this great variety hangeth upon the sole string of *identity*.

Now these Syllogisms, being as it were interlaced and woven one within another, (so that many of them do make a long chain, whereof each of them is a link) do breed, or rather are all the variety of mans life : they are the steps by which we walk in all our conversations, and in all our businesses: man as he is man, doth nothing else but weave such chains : whatsoever he doth, swerving from this work, he doth as deficient from the nature of man: and if he do ought beyond this, by breaking out into divers sorts of exteriour actions, he findeth nevertheless in this linked sequel of simple discourses, the art, the cause, the rule, the bounds, and the model of it.

3.

That the life of man as man, doth consist in discourse, and of the vast extent of it.

Let us take a summary view of the vast extent of it, and in what an immense Ocean one may securely sail, by that never-varying Compass, when the Needle is rightly touched, and fitted to a well-moulded box ; making still new discoveries of Regions, far out of the sight and belief of them, who stand upon the hither shore. Humane operations are comprised under the two general heads of *Knowledge* and of *Action* : if we look but in grosse, upon what an infinity of divisions these branch themselves into, we shall become giddy, our brains will turn, our eyes will grow weary and dim, with aiming only at a suddain, and roving measure of the most conspicuous among them, in the way of knowledge.

We see what mighty works men have extented their labours unto ;

unto; not only by wild discourses, of which huge volumes are composed, but even in the rigorous method of Geometry, Arithmetick, and Algebra; in which, an *Euclide*, an *Appollonius*, an *Archimedes*, a *Diophantus*, and their followers, have reached such admirable heights, and have wound up such vast bottoms, sometimes shewing by effects, that the thing proposed must needs be as they have set down, and cannot possibly be any otherwise; otherwhiles, applying the understanding (which is never truly at rest, till it hath found the causes of the effects it seeth) by exposing how it cometh to be: so that the Reader calling to minde, how such a thing was taught him before, and now finding another unexpectedly convinced upon him, easily seeth that these two put together, do make and force that third to be, whereof he was before in admiration how it could be effected: which two waies of discourse, are ordinarily known by the names of *Demonstrations*; the one called *à priori*, the other *à posteriori*.

Dialo : de
mundo.

Now if we look into the extent of the deductions out of these, we shall finde no end. In the heavens, we may perceive Astronomy measuring whatsoever we can imagine; and ordering those glorious lights, which our Creator hath hanged out for us; and shewing them their waies, and pricking out their paths, and prescribing them (for as many ages as he pleaseth before hand) the various motions they may not swarve from in the least circumstance. Nor want there sublime souls, that tell us what mental they are made of, what figures they have, upon what pillars they are fixed, and upon what gimbals they move and perform their various periods: witnesse that excellent and admirable work, I have so often mentioned in my former Treatise. If we look upon the earth, we shall meet with those, that will tell us how thick it is, and how much room it taketh up: they will shew us how men and beasts are hanged unto it by the heels; how the water and air do cover it; what force and power Fire hath upon them all; what working is in the depths of it; and of what composition the main body of it is framed: where neither our eyes can reach, nor any of our senses can send its messengers to gather and bring back any relations of it. Yet are not our Masters contented with all this: the whole world of bodies is not enough to satistie them: the knowledge of all corporal

real things, and of this machine of heaven and earth, with all that they enclose, cannot quench the unlimited thirst of a noble minde, once set on fire with the beauty and love of Truth.

*Æstuat infelix, angusto limite mundi,
Ut Gyarae clausus scopulis, parvâque Seripho.*

But such heroick spirits, cast their subtile nets into another world, after the winged inhabitants of the heavens; and finde means to bring them also into account, and to serve them (how imperceptible soever they be to the senses) as dainties at the souls table. They enquire after a maker of the world we see, and are our selves a main part of; and having found him, they conclude him (out of the force of contradiction) to be eternal, infinite, omnipotent, omniscient, immutable, and a thousand other admirable qualities they determine of him. They search after his tools and instruments, wherewith he built this vast and admirable Palace, and seek to grow acquainted with the officers and stewards, that under him govern this orderly and numerous family. They finde them to be invisible creature, exalted above us more than we can estimate, yet infinitely farther short of their and our Maker, than we are of them. If this do occasion them to cast their thoughts upon man himself, they finde a nature in him (it is true) much interior to these admirable *Intelligences*, yet such an one, as they hope may one day arrive unto the likeness of them: and that even at the present, is of so noble a mould, as nothing is too big for it to fathom, nor any thing too small for it to discern.

Thus we see knowledge hath no limits; nothing escapeth the toyls of Sciences; all that ever was, that is, or can ever be, is by them circled in: their extent is so vast, that our very thoughts and ambitions are too weak and too poor to hope for, or to aim at what by them may be compassed. And if any man, that is not inured to raise his thoughts above the pitch of the outward objects he converseth daily with, should suspect that what I have now said, is rather like the longing dreams of passionate lovers, whose desires feed them with impossibilities, than that it is any real truth; or should imagine that it is but a Poetick Idea of Science, that never was nor will be in act: or if any other, that hath his discoursing faculty vitiated and

per-

perverted, by having been imbued in the Schools with unsound and umbratile principles, should perswade himself, that howsoever the pretenders unto learning and science, may talk loud of all things, and make a noise with Scholastick terms, and perswade their ignorant hearers that they speak and unfold deep mysteries, yet in very truth, nothing at all can be known: I shall beseech them both to suspend their conjectures or beliefs herein, and to reserve their censure of me, whether or no I have strained too far, untill the learned Author of the Dialogues of the world, have enriched it with the work he hath composed of Metaphysicks: in which, going orderly and rigorously by continued propositions, in such sort as Mathematicians demonstrate their undertakings, he hath left no scope for wrangling brains to make the least cavil against his doctrine: and casting his sharp-sighted thoughts over the whole extent of Nature, and driving them up to the Almighty Author of it, he hath left nothing out of the verge of those rules, and all-comprehending principles he giveth of true Science. And then I doubt not, but they will thoroughly absolve me from having used my amplification, in aiming at the reach of this algrasping power. For my part, the best expression that I am able to make of this admirable piece, I must borrow from witty *Galileus*, when he speaketh of *Archimedes* his long missed Book of glasses; and professes, that having some of the Elements or Books of it entrusted in my hands by the Author, I read them over with extreme amazement, as well as delight, for the wonderful subtilty, and solidness of them.

4. Thus much for Knowledge. Now let us cast an eye upon humane actions. All that we do (if we do it as we should do, and of humane actions, and of like men) is governed and stiered be two sorts of qualities: the those that concern our selves one of which, we call *Arts*; the other *Prudences*. An art, is a collection of general rules, comprehending some one subject, upon which we often work. The matters we work upon (out of which the particular subjects of Arts do spring) are of three kinds: our selves, our neighbours, and such dumb or insensible things, as compose the rest of the world.

Our actions upon our selves, are the highest and the noblest of all the rest, and those by which we live and work as men: or to expresse my self better, they are those by which we perfect that

that part of us, which maketh us men, and by which we direct and level all we do, according to the rule of reason; not suffering our actions to swerve from what she dictateth unto us. This is done, by multiplying and heightning the thoughts of those things, which maintain us in reason; whether the motives be moral, as the examples of worthy persons, and the precepts and perswasions of wise men, and the like, or whether they be natural, as the consideration of the sweet and contented life, which vertue giveth us here, by good conversation, honor, profit, quiet, pleasure, and what else soever groweth out of so excellent a root: as also, of the beatitude and happy state it bringeth us to in the next; and of the contrary effects which spring from vice. Again, by observing the motives and waies of our passions and animal desires, we learn how to prevent them; how to terrifie them; and how to wear them gently away by little and little, through sometimes giving them diversions, through otherwhiles restraining them with moderation, and through oftentimes cutting of the occasions, and abridging them of their natural encreasings. All these things are brought into art and rule; whose lessons, were men but as careful and industrious to study, as they are to become Masters in vain and trivial things, they would enjoy happy lives.

In the next place, we are to consider the actions whereby we work upon our neighbours. They are chiefly *government* and *negotiation*: both which are of one kinde; and have but this difference, that the one is done in common, the other is performed in particular. The means by which we command, are rewards and punishments: which who hath in his hands, may assuredly by wise using them, bring to passe whatsoever he hath a minde unto.

5.

Of humane actions as they concern our neighbours.

Upon occasion of mentioning these two powerful motives, which have so main an influence in mens actions, we may note by the way, that many of them, and that work most forcibly upon mens minde, are things whose subtilence we know not where to finde; as honor, praise, glory, command, singularity, eminency, shame, infamy, subjection, reproach, and the like: unto any of which, none of our senses can reach; and yet they govern mans life, in a manner wholly and perfectly.

In *negotiation*, we propose to single men their own interests and profits; not such as the proposer can, or will effect; but

C c c

such

such as are likely to arise out of the action we endeavour to draw him unto with whom we treat. In both these, the usual labour is, to make our neighbours willing to leave some present good, in hope of a greater to come; or to be content to undergo some present harm, for fear of a greater to ensue. The general instrument which they use, is *discoursing*; whose vertue consisteth partly in our own minde, and partly in delivering our minde to others: for first we must know what we should say, and next in what manner we should say it.

6.
Of Logick.

The art which directeth our own minde, and teacheth us what to say, is *Logick*: whose parts are two; according as the affairs falling into discourse, are likewise of a twofold nature: the one instructeth us how to manage and order our reason, when it dealeth with such subjects as we may attain to certainty in. And here the rules of *Demonstration* take place; teaching us to define, to divide, and to conclude. The other instructeth us how to behave our selves, when we meet with such subjects, as a good and probable guess is the farthest we can reach unto towards the knowledge of them: and for these, the *Topical* part of *Logick* serveth; the which, taking a view of all the accidents belonging to any thing propounded, sheweth how to draw probabilities from every one of them.

7.
Of Grammar.

Our discoursing to others, is either to open our mindes barely unto them; or to perswade them of somewhat our selves believe; or to winne them to somewhat we would have them do. For the bare delivery of our mindes to others, we have *Grammar*; the scope of which art, consisteth first, in teaching us to deliver our conceptions plainly and clearly, (which is the main intent of speaking) next in making, our discourse be succinct and brief, (which is the measure of our speaking, both for our selves and others;) and lastly, in sorting our words, so as what we say, may be accompanied with sweetness; both in common, in regard of the ear, by avoyding such harsh sounds as may offend it; and in particular, in regard of the custom of the language wherein we speak, and of the persons to whom we speak.

8.
Of Rhetorick.

The art whereby we may perswade others, and winne them to assent unto what we would have them, is *Rhetorick*. Her rules instruct us how to dispose and order with best advantage, in regard of

of the Auditours disposition, both the reasons which *Logick* affordeth us, and the words which *Grammar* storeth us with: as also, how to give life and motion to what we say, by our action and gesture; that so we may perswade our Auditory, such passions reign in us, as we seek to stir up in them: for as we may observe, that one who yawneth, maketh another likewise yawn; and as our seeing others laugh, provoketh laughing also in us (the reasons whereof we have touched in the former Treatise;) after the same manner, what passion soever we exhibite in our selves, the same stealeth insensibly upon those we speak unto; whiles their minde attending to the words they hear, is not aware of the subtile spirits motions, that by a kind of contagion rise and swell in their hearts: according to which natural inclination in all men, the Master of Poets, and excellent observer of mens humours said passing well:

Si vis me flere, dolendum est

Primum ipsi tibi.

Hence grow those encreases by metaphors, hyperboles, and other tropes and figures: hence those fervors by interrogations, exclamations, apostrophes, and the like; which when they are fitly placed, they carry the Auditour even against his will.

Poetry, is not a governour of our Actions, but by advantageous expressing some eminent ones, it becometh an useful director to us; and therefore challengeth a place here. The design of it is, by representing humane actions in a more august and admirable hew, then in themselves they usually have: to fram specious Ideas, in which the people may see, what is well done, what amiss, what should be done, and what by error is wont to be done: and to imprint in mens mindes a deep conceit of the goods and evils, that follow their vertuous or vicious comportment in their lives.

If those who assume the title of *Poets*, did aim at this end, and would hold themselves strictly to it, they would prove as profitable instruments as any the commonwealth had: for the delightfulness and blichness of their compositions, invitch most men to be frequently conversant with them; (either in songs, or upon the Stage, or in other Poems) whiles the sober aspect and severity of bare precepts, deturneth many from lending a pleased

9.
Of Poetry.

car to their wholesome doctrine; and what men swallow with delight, is converted into punishment: so that, if their drift were to fettle in mens mindes a due valuation of vertue, and a detestation of vice, no art would do it more universally, nor more effectually: and by it, mens hearts would be set on fire to the pursuit of the one, and be shrunk up with dislike and horror against the other. But unto such a Poet as would aim at those noble effects, no knowledge of *Morality*, nor the nature and course of humane actions and accidents must be wanting: he must be well versed in *History*; he must be acquainted with the progresse of nature, in what she bringeth to passe; he must be deficient in no part of *Logick*, *Rhetorick*, or *Grammar*: in a word, he must be consummate in all Arts and Sciences, if he will be excellent in his way.

10.
Of the power
of speaking.

But whiles we thus entertain our selves with those Arts, which serve us in discoursing with others, it were a great oversight to forget that faculty, which is the *basis* and ground-work of all those: and that is, the power of speech, which nature hath bestowed upon us. It consisteth in two actions: the one outward, the other inward: the outward, is the giving of various sounds to our breath, as it passeth through our mouth, by divers conjunctions of our tongue, teeth, and lips, to themselves, or to divers parts of our mouth, or by their separations from them: in which, we see that birds are able to imitate us, and I am perswaded, the like might be effected by insensible creatures; if a dexterous man would employ his time, in contriving and making an instrument to expresse those different sounds; which, nor having more than seven substantial differences besides the vowels (as some who have carefully noted them, do affirm) it would peradventure be no hard matter to compose such an engine.

The inward action of locution, is the framing of convenient answers to what is asked; of fit replies to what is said; and in a word, to speak appositely, and to the purpose: whereunto, neither beast nor dead instrument can be brought, unless the artificier be able to endue it with understanding.

11.
Of arts that
concern dumb
and insensible
creature.

All other Arts, instruct us how to work orderly upon beasts and insensible bodies: by some of them, we cultivate living creatures, as when husband-men nourish sheep, oxen, fowl, and the like, for slaughter: by others, we discipline them, as when we teach

teach horses, dogs, apes, hawks, parrats, and some kinde of fishes, to hunt, to play, and in a word, to do somewhat either for our profit, or for our pleasure : and again, by others we use their natures to our ends ; as when we lay baits to catch them, when we set egges under hens, to have the chickens, and the like : by other arts, we work as powerfully upon insensible creatures ; among which, by knowing the natures of divers trees, herbs, minerals, &c. we are able to bring any of them to what use soever we finde most expedient for our service : from hence grow all those Arts and Trades, in which we see men daily spend their whole lives ; so as it is needlesse to insist upon the particulars of them, since Townes and the Cities are composed of the severall Tribes of persons that profess them and live by them.

But we must not leave this subject, without noting how admirably mans wit turneth it selfe to so different sorts, and to such an infinite variety of things. For what man is there, (if he be a man) but might have become Master in any of these so differing Trades, in case he had applyed himself as constantly to that, as he hath done to some other he is perfect in ? Again, let us consider how it happeneth often, that he doth not the same thing twice the same way, but according to his own, or another mans fancies, changeth his work at will, now doing it after one fashion, now after another ; as having no law or determination from Nature, but being wholly left to his own direction :

There remaineth one art, not yet spoken of ; which knoweth not where to challenge a place, whether among the moderatours Of Arithmetick. 12.
of our own actions, or among those whereby we govern things : tick.
and that is *Arithmetick* : which seemeth to belong unto things, and yet it medleth not with them : and again, it seemeth to be a main directour of our internall actions, and yet belongeth neither to *Morals*, nor to *Logick*. Wheresoever its due be to place it, I am sure its not to be forgotten ; seeing it is so principal an one, as our life can hardly consist without it. It worketh upon notions that are no where ; for every thing that is in the world, is but one ; and to be, or to make a number, cannot happen without an understanding : the affections likewise of them, are as the subject, all invisible ; as to be even or odde, to be cubes, squares, roots, &c. and yet how great the power and extent of this
C c c 3 art

art is, none can rightly understand or believe, but he that hath the knowledge of it, or hath seen the vertue and efficacy of it.

13.
Of Prudence.

All these arts, consist in common rules, which require the second of those qualities, whereby we said humane actions are governed, to apply them to their particular matter: and that is *Prudence*; which we may define to be, a quality or power, by whose assistance we apply unto the matter we are to work upon, such instruments, as in our present judgement appear fittest to bring it to that passe, which serveth best for our intentions, when by our senses, or by other guesses, we know the particular dispositions of the matter, and of the instruments wherewith we are to change it. Now howbeit this occurreth generally in all arts, yet its special place and necessity, is in governing and moderating our own or other mens *Morall* actions; and accordingly, its name is especially addicted thereunto: and that man is said to be prudent or discreet, who governeth himself and others well.

This quality of *Morall Prudence* in generall, is divided into three particular ones: the first of which belongeth to a governour in a State or Commonwealth: the next may be assigned to him that is skilful in the laws: and the third concerneth the managing and conduct of military actions. The reason of this long received distribution peradventure is, because in these occurrences, our passion swayeth us generally more then in any others: and the operation and effect of *Prudence*, (whose Province is to curbe and moderate our passions by reason) is greatest, and appeareth most in those subjects, where passion reigneth usually with greatest impetuosity.

14.
Observations
upon what
hath been said
in this Chap-
ter.

Thus have we runne over the main parts of discourse, and the general heads of mans action as man: which peradventure may through their numerousnesse, appear to be as it were but loosely scattered from our pen; (as happeneth unto all materials, that must serve for after buildings; and that till they be employed, require no more but sorting, and laying together in several heaps, to the end they may be ready for use:) and therefore before we go any farther, it will not be amisse to make reflexions upon what we have said; and to draw it neerer our intended scope; and to square out and give some figure and polishing

polishing to these stones, here where we digge them out of the quarry, whereby they may hereafter with lesse ado, fit the places we have assigned them, in the structure we intend: and so, a little trouble here, whiles our tools are still in our hands, and our matter lyeth ready for our stroake, and our thoughts are warm with working upon them, may save us a great deal there, where our main imployment will be, to lay artificially; and to joyn closely, what now we but hew out: and therefore will require finer instruments, and a sharper edge, than what at present serveth our turn.

Let us then bring back to account all we have said in this Chapter: and when we have well reflected upon every particular, we shall finde they all agree in this, that they are nothing else but a due ordering of one thing with another: a syllogism is an ordering of some few notions: a Science is an ordering of syllogisms, in such sort, as a new Proposition may follow out of those which went before: and as we see that when by our thoughts divers syllogisms are well ordered, hidden things come to be disclosed in our understanding; even so among bodies, if things whose proprieties are known, be likewise ordered and put together, those very effects, which were discovered by the ordering of notions in our head, will spring forth in nature: as for example, if by knowing the natures of fire and of towne, our discourse findeth that towne put to fire will presently become fire, the same will happen in nature, if we put material towne, or some other body that hath the qualities of it, to real fire, or to some other substance that is endewed with the vertues of fire: in like manner, if by knowing that colours are nothing else, but various mixtures of light and of darknesse in bodies, our discourse assureth us, that by severall compoundings of these extremes, red, blewes, yellows, greens, and all other intermediate colours may be generated; accordingly we shall finde in effect, that by the severall minglings of black and white bodies (because they reflect or drowne light most powerfully) or by interweaving streames of pure light and of shadowes one with another, we may procreate new colours in bodies, and beget new luminous appearances to our eyes: so that hence it appeareth clearly, that the same nature is in our understanding, and in the things: and that the same ordering, which in

the one maketh Science, in the other causeth natural transmutions.

Another reflexion; which will be fit for us to make upon these long discourses, is this, that of necessity there must be a joyning of some things now actually in our knowledge, unto other things we think not of: for it is manifest, that we cannot at the same time actually think of a whole book of *Euclide*; and yet to the due knowledge of some of the last Propositions, the knowledge of almost all the former is required: likewise it is impossible we should at the same time think of all the multitude of rules belonging to any art, as of Grammar, of Metering, of Architecture; and yet when we write in Latine, make a Poem, or lay the design of a house, we practise them whiles we think not of them, and are assured we go not against them, however we remember them not.

Nay, even before we know a thing, we seem to know it; for since we can have a desire of nothing, but of what we know, how could we desire to know such or such a thing, unless we know both it, and the knowledge of it? And for the most part we see a horse, or man, or herb, or workmanship, and by our sense have knowledge that such a thing it is, before we know what, or who, or how, it is: that groweth afterwards out of the diligent observation of what we see: which is that, whereby learned men differ from the unlearned, for what striketh the sense, is known alike by them both; but then here is the difference between them, the latter sort sitteth still with those notions, that are made at the first, by the beating of our sense upon us, without driving them any farther: and those that are learned, do resolve such compounded notions, into others made by more common beatings, and therefore more simple: and this is all the oddes in regard of knowledge, that a Scholar hath of an unlettered man.

One observation more we will draw out of what we have said, and then end this Chapter: it is, how a man doth oftentimes enquire among his own thoughts, and turneth up and down the images he hath in his head, and beateth his brains, to call such things into his minde, as are useful unto him, and are for the present out of his memory: which, as we see it so necessary, that without it no matter of importance can be performed in the way
of

of discourse (whereof I my self have too frequent experience in the writing of this Treatise) so on the other side, we cannot perceive that any creature besides Man, doth it of set purpose and formally as Man doth,

THE FROUTH CHAPTER.

How a man proceedeth to Action.

HAVING thus taken a summary view of the principal Qualities a man is endued withal, *Apprehending Judging,* and *That humane Discoursing*; and having shewed how he is enriched in and by actions proceed from two several principles, Understanding and Sense, they sway by turns, and sometimes joyn together, to produce a mixed action of both.

If onely Sense were the fountain from whence his actions spring, we should observe no other strain in any of them, then meerly that according to which Beasts perform theirs: they would proceed evermore in a constant unvariable tenour, according to the law of material things, one body working upon another, in such sort as we have declared in the former Treatise.

On the other side, if a man were all understanding, and had not this bright lan penclosed in a pitcher of clay, the beams of it would shin without any allay of dimnesse, thorough all he did; and he could do nothing contrary to reason, in pursuit of the highest end he hath prefixed unto himself; for he neither would, nor could do any thing whatsoever, untill he had first considered all the particular circumstances, that had relation to his action in hand; and had then concluded, that upon the whole matter, at this time, and in this place, to attain this end, it is fitting and best to do thus or thus: which conclusion could be no sooner made, but that the action would without any further disposition on his side, immediately ensue, agreeable to the prin-

principles it springeth from. Both parts of this assertion are manifest: for the first, it is evident, that whensoever an Agent worketh by knowledge, he is unresolved whether he shall work or not work, as also of his manner of working, until his knowledge (that ought to direct and govern his working) be perfect and compleat: but that cannot be, as long as any circumstance not as yet considered, may make it seem fit or unfit to proceed: and therefore, such actions as are done without exact consideration of every particular circumstance, do not flow from a pure understanding. From whence it followeth, that when an understanding is not satisfied of every particular circumstance, and consequently cannot determine what he must immediately do, but apprehendeth that some of the circumstances not as yet considered, may (or rather must) change some part of his action, it must of necessity be undermined in respect of the immediate action; and consequently, it must refrain absolutely from working. The other part is clear; to wit, that when the understanding, upon consideration of all circumstances, knoweth absolutely what is best, the action followeth immediately (as farre as dependeth of the understanding) without any farther disposition on his behalf: for seeing that nothing but knowledge belongeth to the understanding, he who supposeth all knowledge in it, alloweth all that is requisite or possible for it to work by: Now if all be put, nothing is wanting that should cause it to work: but where no cause is wanting, but all requisite causes are actually being, the effect must also actually be, and follow immediately out of them: and consequently, the action is done, (in as much as concerneth the understanding, and indeed absolutely, unlesse some other cause do fail) as soon as the understanding knoweth all the circumstances belonging to it: so as it is manifest out of this whole discourse, that if a man wrought onely by his understanding, all his actions would be discreet and rational, in respect of the end he hath proposed to himself; and till he were assured what were best, he would keep himself in suspense and do nothing; and as soon as he were so, he would admit of no delays, but would at the instant proceed to action according to his knowledge: the contrary of all which, we daily see by experience in every man.

We:

We may then safely conclude, that in humane nature there are two different centers, from whence cross actions do flow : the one he hath common with beasts, and whose principles and laws we delivered in the former Treatise, where we discoursed of life, and the motions of life and of passions : the other is the subject of our present enquiry ; which in this place, expecteth at our hands, that we should consider how it demeaneth it self, and what it doth in us, when by its guidance we proceed to any action. Experience must be our informer in general : after which, our discourse shall anatomise what that presenteth us in bulk. She giveth us notice of three especiall effects of our understanding : first, that it ordereth aright those conceptions which are brought unto it ; secondly, that when they appear to be not sufficient for the intended work, it casteth about and seeketh out others : and thirdly, that it strengthneth those actions which spring from it ; and keepeth them regular and firm and constant to their beginnings and principles. Unto which last seemeth to belong, that it sometimes checketh its own thoughts, and bringeth back those it would have, and appeareth to keep as it were a watch over its own waies.

As for the ordering of the present notions, it is clear that it is done by a secret dependance from the rules of discourse, and from the maxims of humane action : I call this dependance a secret one, because a man in his ordinary course, maketh use of those rules and *maxims* which serve his turn, as though they were instilled into him by Nature, without so much as ever thinking of them, or reflecting upon them to square out his actions by them : nay, some of them so far out of the reach of most men, as they cannot think of them, though they would ; for they know them not : as in particular, the rules of discourse ; the use of which is so necessary, as without it no man can converse with another, nor do any thing like a man, that is, reasonably. From whence then can this proceed, that so familiarly & readily a man maketh use of what he is not conscious to himself that he hath any acquaintance withal ? It can be nothing else, but that the soul, being in her own nature ordered to do the same thing, which Scholars with much difficulty arrive to know what it is by reflection and study, and then frame rules of that afterwards carry their discourse to a higher pitch, she by an inborn vertue maketh

2.

How our general and inbred maxims do concur to humane action.

maketh a man do it orderly, constantly, and certainly.

3.
That the rules
and maxims
of arts do
work positive-
ly in us though
we think not
of them.

The like may be observed in the daily use men make of the *maxims* of humane action: which are certain knowledges that formerly they have gotten, but that they usually think not of, whiles they work agreeable to them; yet it seemeth they work by them; for if their action should jarre against any of them, they would presently reflect upon their *Maxime*, and by it correct what they were about: for example, one who is skilled in the rules of *Grammar*, or of accenting his speech, or hath his ear used to *Musick*, whiles he heareth true construction, or even verse, or consonant song, never reflecteth how it is made; or at most doth but consider in grosse that it is right: but if a *solcism*, or false quantity, or discord intervene, he presently is aware, not onely that it is amisse, but remembreth the very particular precise rule against which the breach is made.

This at the first sight might occasion us to imagine, that the rules by which any composition is made, do work onely negatively in us, whiles we are busie about it: that is, that they contribute nothing to the making of the thing, but onely hinder us from committing errors: but if we consider the matter well, we shall finde it impossible, but that they should work even positively in us; for we know that when we first learn any of these things, we look industriously for such a gender, or number, or case, or tense, for such a foot or quantity, such a note, or consonance; and we are sure, that use and practise of the same thing, doth not change, but onely facilitate the work: therefore it followeth of necessity, that we still use those very instructions, by which at the first we could but slowly creep, but now manage them with such celerity, as our fanisie cannot keep pace with what we do. And this is the reason why we do not perceive that we think of them, but may peradventure at the same time think of a quite different matter; as when a Musician playeth voluntary division upon a ground he never saw before, and yet hath all the while some other thought in his head; or when a Painter draweth a picture, and all the while discourseth with a by-stander.

This truth may be convinced by another argument: as thus; it cannot be doubted, but that a verse or song is made by the power of making such compositions: but that power is the art of them; and that art is nothing else but the rules whereby they are made:

made: and accordingly we see, that who hath not the art, cannot make such compositions: but who hath, can when he pleaseth: and if any man would be able to make them, he presently studyeth the art: so that it cannot be doubted, but that artificial things are alwaies made by the use of those rules which teach the making of them; although for the most part we are not able to perceive how such rules are used: and besides this, we are sure that we do not onely make use of those rules we learned at the first, but when we are arrived to Mastery in any art, we make use of them in a quite different manner then we did in the beginning, and then we do in any other thing, wherein we finde pain and difficulty.

In the second effect that we experience of our understanding, (which is, our casting about for new conception, when those it already hath, appear not sufficient to direct what it hath in hand) the force and working of it, is very evident: for this effect proceedeth out of a want of satisfaction: and this belongeth properly to the understanding; for if evidence and satisfaction be qualities of it, then of necessity the privation of these qualities, must likewise belong unto it: as also to discern that privation, and to use means to avoid it: and in the very casting about, we see a choice made: and that things are not taken promiscuously as they come of a row, but that some of them are set aside, and others advanced for use: which argueth plainly the knowledge and government of the understanding.

4.

How the understanding doth cast about when it wanteth sufficient grounds for action.

But the third operation, is that which giveth clearest evidence of the peculiar and distinct working of the understanding: for if we mark the contestation and strife within us, between our sensual part and his antagonist which maintaineth the resolution set by reason, & observe how exceedingly their courses and proceedings differ from one another; we shall more plainly discern the nature, and power, and efficacy of both of them. We may perceive that the motions against *Reason*, rise up turbulently, as it were in billows, and like a hill of boyling water (as truly *Passion* is a conglobation of spirits) do put us into an unquiet and distempered heat and confusion: on the other side, *Reason* endeavoureth to keep us in our due temper, by sometimes commanding down this growing sea; otherwhiles, by contenting in some measure the desires of it, and so diverting another way

5.

How reason doth rule over sense and passion.

way its unruly force : sometimes she terrifieth it, by the proposal of offensive things joyned unto those it is so earnest to enjoy : Again, sometimes she preventeth it, by cutting off all the causes and helps that promote on its impotent desires, and by engaging before hand the power of it in other things, and the like.

All which do evidently convince, that as *Reason* hath a great strength and power in opposition of sense, so it must be a quite different thing, and of a contrary nature unto it : we may adde, that the work of *Reason* can never be well performed, but in a great quiet and tranquillity ; whereas the motions of *Passion*, are alwaies accompanied with disorder and perturbation : so as it appeareth manifestly that the force of *Reason*, is not purely the force of its instruments, but the force of its instruments as they are guided. and as the quantities of them are proportioned by it : and this force of *Reason*, is different from the force of its instruments in themselves, in such sort as the force of a song, is different from the force of the same sounds, whereof it is composed, taken without that order which the Musician putteth in them: for otherwise the more spirits that are raised by any thought (which spirits are the instruments whereby *Reason* performeth all her operations in us) the more strongly *Reason* should work ; the contrary of which is evident, for we see that too great abundance of spirits confoundeth *Reason*.

6. This is as much as at present I intend to insist upon, for proof
 How we recal that our understanding hath its proper & distinct operations, and
 our thoughts worketh in a peculiar manner, & in a quite different strain from
 from distracti- all that is done by our senses. Peradventure some may conceive,
 ons. that the watchfulness and recalling of our thoughts back to their
 enjoined work, when they break loose and run astray, and our not
 letting them range abroad at random, doth also convince this as-
 sertion : but I confesse ingeniously, the testimony of it seemeth
 not clear to me ; and therefore I rank it not with those, that I
 would have (if it may be) solidly weighty, and undeniable to
 who shall consider maturely the bottom and full efficaciousness
 of them. Of such, a few, or any one, is enough to settle ones minde
 in the belief of a truth : and I hope, that this which we have la-
 boured for in this Chapter, is so sufficiently proved, as we need
 not make up our evidences with number of testimonies.

But

But to shew the exception I take against this argument, let us examine, how this act within us which we call watchfulness, is performed: truly, we thinketh it appeareth to be nothing else, but the promptitude and recourse of some spirits, that are proper for this effect, which by a mans earnestness in his resolution, do take a strong impression, and so are still ready to knock frequently at the door of our understanding, and thereby enable it with power to recall our strayed thoughts. Nay, the very reflexion it self, which we make upon our thoughts, seemeth unto me to be only this, that the object beating upon the fanſie, carryeth back with it at its retyring from thence, some little particle or atome of the brain or *Septum Lucidum*, against which it beateth, sticking upon it; in like manner as upon another occasion, we instanced in a ball rebounding from a green mudde wall, unto which some of the matter of the wall must needs adhere: now this object, together with the addition it getteth by its stroak upon the fanſie, rebounding thence, and having no more to do there at present, betaketh it self to rest quietly in some cell it is disposed into in the brain, as we have delivered at large in our former Treatise, where we discoursed of *Memory*: but whensoever it is called for again by the fanſie, or upon any other occasion returneth thither, it cometh as it were capped with this additional piece it acquired formerly in the fanſie; and so maketh a representation of its own having been formerly there.

Yet, be these actions performed how they will, it cannot be denied, but that both of them are such, as are not fit, nor would be any waies usefull to creatures, that have not the power of ordering their own thoughts and fanſies, but are governed throughout meerly by an uniform course of nature: which ordering of thoughts, being an operation feasible onely by rational creatures, and by none others, these two actions (which would be in vain, where such ordering is not used) seem to be specially ordained by Nature, for the service of *Reason* and of the *Understanding*; although peradventure a precise proper working of the understanding, do not clearly shine in it. Much less can we by experience finde among all the actions we have hitherto spoken of, that our *Reason* or *Understanding* worketh singly and alone by it self, without the assistance and consortship of the

the fantasie : and as little can I tell how to go about to seek any experience of it.

7.
How reason
is sometimes
overcome by
sense and pas-
sion.

But what *Reason* may do in this particular, we shall hereafter enquire : and end this Chapter, with collecting out of what is said, how it fareth with us, when we do any thing against *Reason*, or against our own knowledge. If this happen by surprise, it is plain that the watch of *Reason* was not so strong as it should have been, to prevent the admittance or continuance of those thoughts, which work that transgression. Again, if it be occasioned by *Passion*, it is evident that in this case, the multitude and violence of those spirits which *Passion* sendeth boyling up to the fantasie, is so great, as the other spirits, which are in the jurisdiction and government of *Reason*, are not able for the present to ballance them and stay their impetuosity, whiles she maketh truth appear. Sometimes we may observe, that *Reason* hath warning enough, to muster together all her forces, to encounter, as it were in set battail, the assault of some concupiscence, that sendeth his unruly bands to take possession of the fanfic, and constrain it to serve their desires, and by it to bring *Reason* to their bent. Now if in this pitched field she loose the bridle, and be carryed away against her own resolutions, and be forced like a captive to obey the others laws, it is clear that her strength was not so great as the contrary factions,

The cause of which is evident; for we know that she can do nothing, but by the assistance of the spirits which inhabit the braine : now then it followeth, that if she have not the command of those spirits which flock thither, she must of necessity be carryed along by the stream of the greater and stronger multitude ; which in our case, is the throng of those that are sent up into the brain by the desired object ; and they come thither so thick and so forcibly, that they displace the others which fought under *Reasons* Standard : which if they do totally, and excluding *Reasons* party, do entirely possess the fanfic with their troops, (as in madnesse and in extremity of sudden passion it happeneth) then must *Reason* wholly follow their sway, without any struggling at all against it ; for whatsoever beateth on the fanfic, occasioneth her to work ; and therefore when nothing beateth there but the messengers of some sensual object, she can
make

make no resistance to what they impose : but if it happen that these tumultuary ones, be not the onely spirits which beat there, but that *Reason* hath likewise some under her jurisdiction, which keep possession for her, though they be too weak to turn the others out of doors ; then it is true, she can still direct fairly, how in that case a man should govern himself ; but when he cometh to execute, he findeth his sinews already possid, and swelled with the contrary spirits ; and they keeping out the smaller and weaker number, which reason hath ranked in order, and would furnish those parts withal, he is drawn even against his judgement and *Reason*, to obey their appetites, and to move himself in prosecution of what they propose ; in such sort as the Poet expresseth that *Medea* found in her self, when she complained and bemoaned her self in these words, *Video meliora proboque, Deteriora sequor* : and in this case, a man foreseeeth his misery all the way he rouleth towards it, and leapeth into the precipice with his eyes open : which sheweth that the army of thoughts on *Reasons* side, should be increased in number, to have her strong enough to wage battel with the rebellious adversary : or else, that her adversary should be so much weakened, that she, though not grown stronger in her self, yet might, through the others enfeebling, be able to make her party good ; (and hence is the use of corporeal mortifications, to subject our *Passions* to the behest of *Reason*) even as when we see, that when we are in health, our arms, and legs, and all our limbs, obey our will, reaching what we command them, and carrying us whither we desire, because the spirits which are sent into them from our brain, are strong enough to raise and move them as they are directed ; but if our sinews be so steeped in some cold and watry humour, that the spirits coming down, find not means to swell and harden them ; well we may wish and strive, but all in vain : for we shall not be able to make them perform their due functions. In like manner, if *reason* do send her emissaries into the same arm or leg, or other member, and no other spirits do there strive against them, then that limb is moved and governed absolutely according to her directions : but if at the same time, a greater multitude of others, do hinder *reasons* servants from coming thither, or flocking into other sinews, do carry that limb a contrary way ; in vain doth *reason* strive to move them to her byas ; for those obeying parts must observe the rules which the violent conqueror prescribeth.

D d d

T H E

THE FIFTH CHAPTER.

Containing proofs out of our singular apprehensions, that our soul is intorporeal.

I.
The connecti-
on of the sub-
sequent Chap-
ters with the
precedent.

AS in our first Treatise we dissected nature, and shewed, how out of the notion and first division of Quantity, ariseth that vast multiplicity of things, which filling this world, falleth under the consideration of our senses: so in the beginning of this second Treatise, we have searched into those operations of a man. (attributed to his soul) by which he is conceived to excell all other living creatures: and there discovered, that the admirable and unlimited variety of works, which is seen in mens writings and actions, doth all flow from the source of *single apprehensions*; and even from one bare notion of *Being*: which is the root and principle, from whence all others derive their origine; and into which all may be resolved; works proceeding from resolutions, they from discourses, these being composed of judgements, and judgements of single apprehensions. This part we must now review, and enquire what we can finde in mans operation, arguing the *quality* of his soul; whether it be corporeal or no. For if these single apprehensions, and the processes compounded of them, may be performed by the ordering of rare and dense parts (as the other works of nature are) then they will be corporeal, and of the same kinde with those, which we opened in the first Treatise: but if we shall prove, that they cannot possibly be deduced from multiplicity, and order of quantitative parts, when we may confidently resolve our selves, that in the cause from which they flow, is a nature wholly discrepant from that which resideth among bodies, and among corporeal things.

This we shall here labour to do: and to that end, we will begin our work with reflecting upon what we have delivered of a single apprehension, in the first Chapter of this second Treatise: whose nature we there first explicated in common; and thence proceeded to some particular apprehensions; and lastly, shewed the extent they comprehended: These then must be the subject of our present speculation.

As

As for their nature, we may remember, how we resolved three things: first, that by apprehension, the very thing apprehended is by it self in our soul: next, that the notion of *being*, is the first of all notions, and is resumed in all others: and thirdly, that what is added to the notion of *being*, is but *respects* to other things. Now then let us consider, what kinde of Engines they must be, that may have the power to make things themselves to be in our soul, if they were to be there materially? How shall the place, or the time passed, be removed, and be put in another place, and in another time? How shall the quantity of the heavens, of the whole world, nay of bigness exceeding all that by millions of proportional encreases, be shut up in the little circuit of mans brain? And if we examine our selves strictly, we shall finde nothing wanting; all is there. How shall the same thing be corporaelly in two, nay in two thousand places, at the same time? And yet, in so many is the Sun, when two thousand men think of it at once. We must then allow, that things are there immaterially; and consequently, that what receiveth them, is immaterial: since every thing is received according to the measure and nature of what receiveth it.

But I easily conceive, that the strangeness and incredibility of our Position, may counterballance the force of it: for who can perswade himself, that the very thing he apprehendeth, is in his minde? I acknowledge, that if its being there were to be understood corporeally, it were impossible: but on the other side who shall consider, that he knoweth the thing he rightly apprehendeth, that it worketh in him, and maketh him work agreeable to its nature, and that all the properties and singularities of it may be displayed by what is in him, and are as it were unfolded in his minde, he can neither deny nor doubt, but that it is there in an admirable and spiritual manner. If you ask me how this cometh to pass? And by what Artifice, Bodies are thus spiritualized? I confess I shall not be able to satisfie you: but must answer, that it is done, I know not how, by the power of the soul: shew me a soul, and I will tell you how it worketh: but as we are sure there is a soul, (that is to say, a *Principle* from whence these operations spring) though we cannot see it: so we may, and do certainly know, that this mystery is as we say; though because we understand not the true and compleat na-

nature of a soul, we can as little express the manner, how it is done by a soul. Yet, before we take our leave of this matter of *Apprehensions*, we will in due place endeavour to say something towards the clearing of this obscure point.

3.
The notion of
being, which is
innate in the
soule, doth
prove the
same.

Our second consideration upon the nature of *apprehension*, was, that our primary and main notion, is of *being*. This discovereth some little glimpse of the nature of the soul: for it is manifest that she applyeth this notion, as well to no parts, as to parts: which we proved in the first Treatise, when we shew'd that we have a particular notion of *substance*, distinct from the notion of *quantity*; for quantity and parts being the same, it followeth that if there be a notion supposed by quantity, (as in substance there is) it must of necessity abstract from parts: and consequently, we may conclude, that the notion of *being*, which is indifferently applicable either to quantity or to substance, doth of its own nature wholly abstract either from *Parts*, or from no *Parts*. I then infer: that since this notion of *being*, is the very first and virgin notion our soul is imbued with, or is capable of, and that it is the root of all other notions, and into which she resolveth every other notion, in such sort, as when we have sifted and scarfed the essence of any notion whatsoever, we can discover nothing that is deeper than this, or precedent to it, and that it agreeth so compleatly with our soul, as she seemeth to be nothing else but a *capacity fitted to Being*, it cannot be denied, but that our soul must needs have a very near affinity and resemblance of nature with it: but it is evident, that *Being* hath not of it self any parts in it, nor of it self is capable of division: and therefore it is as evident, that the soul which is framed (as it were) by that pattern and Idea, and is fitted for *Being* as for its end, must also of it self be void of parts, and be incapable of division. For how can parts be fitted to an indivisible thing? And how can two such different natures ever meet proportionably?

If it be objected, that the very notion of *Being*, from whence we estimate the nature of the soul, is accommodable to parts: as for example, we see that substance is endued with quantity: We answer, that even this doth corroborate our proof: for seeing that the substances, which our senses are acquainted with, all, have parts, and cannot be without parts; and yet nevertheless

less in our soul, the notion of such substance is found without parts; it is clear, that such substance hath this meerly from our soul: and because it hath this indivisibility from our soul, it followeth that our soul hath a power and nature to bestow indivisibility upon what cometh into her. And since it cannot be denied, but that if any substance were once existent without parts, it could never after have parts; it is evident, that the nature of the soul is incapable of parts, because it is existent without parts. And that it is in such sort existent, is clear: for this effect of the souls giving indivisibility unto what she receiveth unto her, proceedeth from her as she is existent. Now since this notion of *being*, is of all others the first and Original notion that is in the soul, it must needs above all others, favour most of the proper and genuine nature of the soul: in which, and by which, it is what it is, and hath its indivisibility.

If then it be pressed; how can substance (in reality or in things) be accommodated unto Quantity, seeing that of its self it is indivisible? We answer, That such substance, as is the subject of quantity, and that hath quantity, is not indivisible; for such substance cannot be subsistent without quantity; and when we frame a notion of it, as being *indivisible*; is it an effect of the force of our soul, that is able to draw a notion out of a thing that hath parts, without drawing the notion of the parts: which sheweth manifestly, that in her there is a power above having of parts: which being in her, argueth her existence to be such.

Our last consideration upon the nature of apprehension, was, how all that is added to the notion of *being*, is nothing else but *respects* of one thing to another; and how by these *respects*, all the things of the world come to be in our soul. The evidence we may draw from hence of our souls immateriality, will be not a whit less, than either of the two former: for let us cast our looks over all that committeth into our senses, and see if from one end to another, we can meet with such a thing as we call a *respect*: it hath neither figure, nor colour, nor smell, nor motion, nor taste, nor touch; it hath no similitude to be drawn out of by means of our senses: to be *like*, to be *half*, to be *cause*, or *effect*, what is it? The things (indeed) that are so, have their resemblances and pictures; but which way should a Painter go about to

4.
The same is
proved by the
notion of re-
spects.

draw a *likeness*? Or to paint a *half*, or a *cause*, or an *effect*? if we have any understanding, we cannot choose but understand, that these notions are extremely different from whatsoever cometh in unto us by the mediation of our senses: and then if we reflect, how the whole negotiation of our understanding is *in*, and by *respects*; must it not follow necessarily, that our soul is of an extreme different nature from our senses, and from our imagination? Nay, if we look well into this Argument, we shall see, that whereas Aristotle pretendeth, that *Nihil est in intellectu quod non prius fuit in sensu*; this Maxim is so far from being true, (in rigour of the words) that the quite contrary followeth undeniably out of it; to wit, that *Nihil est in intellectu quod fuit prius in sensu*. Which I do not say to contradict Aristotle (for his words are true in the meaning he spoke them;) but to shew, how things are so much changed by coming into the understanding and into the soul, that although on the one side, they be the very same things, yet on the other side, there remaineth no likeness at all between them in themselves, as they are in the understanding; which is a most evident proof, (when the weight of it is duly considered) that the nature of our soul, is mainly different from the nature of corporeal things, that come into our sense.

5. By this which we now come from declaring, the admiration, how corporeal things can be in the soul, and how they are spiritualized by their own being so, will in part be taken away: for reflecting that all the notions of the soul, are nothing but the general notion of a *substance*, or of a *thing* joyned with some particular *respect*; if we consider, that the respects may be so ordered, that one respect may be included in another, we shall see, that there may be some one respect, which may include all those respects that explicate the nature of some one thing: and in this case, the general notion of a thing coupled with this respect, will contain all whatsoever is in the thing: as for example, the notion of a knife, that it is a thing to cut withall, includeth (as we have formerly declared) all that belongeth unto a knife: And thus you see, how that mystical phrase, of corporeal things being spiritualized in the soul, signifieth no more, but that the similitudes which are of them in the soul, are *respects*.
6. Thus having collected out of the nature of *apprehensions* in common, as much as we conceive needfull in this place to prove our
- That corporeal things are spiritualized in the understanding by means of the souls working in and by respects.
- That the abstracting of notions from all particular and individual accidents, doth prove the immateriality of the soul.

our assertion, our next work must be, to try it we can do the like, by reflecting upon particular *apprehensions*. We considered them of two sorts, calling one kinde, *universal* ones; and the other, *collective* ones: in the universal ones, we took notice of two conditions, the *abstraction*, and the *universality* of them: now truly if we had no other evidence, but what will rise from the first of these, that alone would convince and carry the conclusion: for though among corporeal things, the same may be now in one place, now in another, or sometimes have one figure, sometimes another, and still be the same things, as for example wax or water, yet, it is impossible to imagin any bodily thing whatsoever, to be at any time without all kind of figure, or without any place at all, or indifferent to this or to that; and nevertheless, all things whatsoever, when they are universally apprehended by the soul, have this condition in her, by reason of their abstraction there, which in themselves is impossible unto them. When we say, water, fire, gold, silver, bread, &c. do we mean or express any determinate figure? if we do, none but that precise figure, will serve or content us: but it is evident, that of a hundred different ones, any and every one doth alike intirely satistie us: when we call for money, if we reflect upon our fanſie, peradventure we shall finde there a purse of crowns: nevertheless, if our messenger brings us a purse of pistols, we shall not except against it, as not being what we intended in our mind, because it is not that which was painted in our fanſie: it is therefore evident, that our meaning and our fanſie were different; for otherwise, nothing would have satistied us, but that which was in our fanſie. Likewise in the very word (which is the picture of our notion) we see an indifferency; for no dictionary will tell us, that this word *money* doth not signifie as well pistols as crowns: and accordingly we see, that if our meaning had been precisely of crowns, we should have blamed our selves, for not having named crowns, and not him that brought us pistols, when we spoke to him by the name of money: and therefore it is most clear, that our understanding or meaning is not fixed or determined to any one particular; but it is equally indifferent to all: and consequently, that it cannot be like any thing which entereth by the senses; and therefore not corporeal.

The second condition of *universal apprehensions*, is their *universality*, which addeth unto their abstraction, one admirable par-

7.
That the uni-
versality of ab-
stracted noti-
ons doth prove
the same.

cularity, and it is, that they abstract in such sort, as to express at the same time even the very thing they abstract from. How is it possible that the same thing can be, and not be in the same notion? Yet let a man consider what he meaneth when he saith, *every man hath two eyes*, and he shall see that he expresseth nothing, whereby any one man is distinguished from another: and yet the force of this word *every*, doth express that every man is distinguished from another; so that in truth, he expresseth particularity it self in common. Now let our smartest and ingenuousest adversary, shew or imagine if he can, how this may be done in a picture, or in a statue, or in any resemblance of a body or bodily thing: but if he cannot, let him acknowledge an eminent and singular propriety in the soul, that is able to do it.

Let us reflect, that particularity in a body, is a collection of divers qualities & circumstances; as that it is white, of such a figure, in such a place, in such a time, and an infinitude of such like conditions, conglobated together: then if our soul be a body, the expression of the particularity of a body in the soul, must be a participation in her of such a conglobation, or of such things, conglobated. Now let us imagine if we can, how such a participation should be in common, and should abstract from all colour, all place, and all those things of which the conglobation consisteth, and yet we see that in the soul this is done; and he who saith *Every man*, doth not express any colour, place, or time, and nevertheless he doth by saying so express, that in every man there is a conglobation of color, place, & time: for it could not be *Every one*, unless there were such conglobations to make *every one, one*: & if any conglobation were expressed in this term *Every one*, it would not be *Every one*, but only *one alone*. Now if any coordination of parts can unfold and lay open this riddle, I will renounce all Philosophy & understanding.

Collective apprehensions will afford us no meaner testimony than the other two, for the spirituality of our soul: for although it may seem unto us, before we reflect thoroughly on the matter, that we see, or otherwise discern by our sense, the numbers of things; as that the men in the next room, are there; that the chairs there, are ten; and the like of other things; yet after due consideration, we shall find, that our eye, or sense telleth us but singly of each one, that it is *one*; and so runneth over every one of them, keeping them still each by themselves, under their own several

unities:

That collective apprehensions do prove the same.

unities : but then the understanding commeth, and joyneth under one notion, what the sense kept asunder in so many several ones, as there are *things*. The notion of *three*, or of *ten*, is not in the *things*, but in our minde; for why three rather than five, or ten rather than twelve, if the matter of which we speak were not determined? and such determination of the matter, is an effect of the understanding. If I had spoken of *things*, as I did of men, or of chairs, there had been more than three or ten: it is then evident, that what determined my speech, made the number be three or ten.

Again, we see that the notion of *ten*, is but one notion; for as the name of *ten*, is but one sign, so it argueth, that there is but one notion, by which it is the sign of ten things. Besides, we see that Arithmeticians do finde out the proprieties and particular nature of any determinate number: & therefore we may conclude, that every number hath a definition, and a peculiar nature of its own, as it is a number. If then this definition, or nature, or notion of *ten*, be a corporeal one, it is a corporeal similitude of the object. But is it like to any one of the things, or is it like to all the ten? If to any one, then that one will be *ten*; if it be like to the whole made of *ten*, then that whole being but one, *ten* will be just one, and not ten things.

Besides, to be *ten*, doth expressly imply to be *not one*: how then can that be a material thing, which by being one representeth many? Seeing that in material things, *one* and *many* are opposite, and exclude one another from the same subject? And yet, this notion could not represent many together, but by being one.

Again, if it be a material notion or similitude, it is either in an indivisible of the brain, or it is in a divisible part of it: I mean, that the whole essence of the notion be in every part never so little of the brain, or that one part of the essence, be in one part of the brain, and that another part of the essence, be in another part of the brain: If you say, that the whole essence is in every part of the brain, though never so little, you make it impossible that it should be a body; for you make it the likeness of ten determinate bodies, in an indivisible manner; seeing that what by division groweth not lesse, hath the nature of an indivisible: but if you say, that divers parts of the essence, are in divers parts
of

of the brain, then you make it impossible that the notion of ten, should be indivisible; since it self is composed of several parts.

In a word, ten things cannot be represented materially, but by ten other things: and therefore it is most evident, that the soul which representeth ten by one thing or notion, doth not represent the ten materially: and consequently, that her self is immaterial.

What we have now said, will be confirmed by considering the terms, *All* and *whole*: for it is clear, that these terms also, are of the nature of numbers; but withall, do expresse particularly that no part is wanting. If then the notion of *All* or *whole*, be said to be material or quantitative, it must be divisible: but if you divide it, no part remaineth *All* or *whole*: it is not therefore divisible; and consequently it is not material. And as this argument is manifestly applyable to numbers, so if we look into the arguments concerning numbers, you will finde all them likewise applyable to these terms, *All* and *whole*.

9.
The operations of the soul drawing always from multitude to unity, do prove the same.

Out of what hath been hitherto discovered, we may gather this note: That it is the nature of the soul, to draw from divisibility, to indivisibility; from multitude, to unity; from indeterminateness and confusion, to a clarity and determination: as appeareth evidently in this last example of *Collections*; in which, whether we take numbers, or other collective terms, we see that throughout their natures do consist in such a perfect indivisibility, as no part can be separated without destroying the essence of the notion: nay, things which in themselves are many and consist in parts, do in the minde get an impartible nature; for *ten*, is no longer *ten*, if it be divided: nor *all*, is *all*, if any thing be taken away. In the same manner, though Philosophy teach us, there be neither points in bigness, nor instants in motion or time, yet nature maketh us expresse all bigness by points, and all time by instants; the soul ever fixing it self upon indivisibility.

And this is the reason, why we attribute the nature of substance to all our notions: if we see a thing white, or black, or do, or suffer, or be in a place, or in time; presently in our apprehensions we conceive these modifications of the thing, like substances; and accordingly we call them by substantive names, *Whiteness*
Action,

Action, Ubication, Duration, &c. Now the reason of this is, because a substance, (that is terminated within it self) is a fit and a stably ground for the soul to fix it self upon, whereas these other Appendages of substance, would not afford her easie footing to build her structures upon, if she considered them as truly they are in themselves: and therefore in her notion, she giveth them the qualities of substance: butwithall it happeneth many times, that by her doing thus, if she be not very wary, she is deceived and falleth into grosser error.

One thing more we must remember to take notice of; and it is, that if we will compare the notions in our understanding, with the signs which beating in our fanſie do beget those notions; we shall finde, that these are but barely signs: and do not in their own nature expreſſe, either the notions they raise, or the things they are signs of. This is evident in the images of the sounds we call *words*: for it is clear, they have no likenesse: either with the things they signifie, or with the thoughts they beget in us: and we shall finde it no less true of other images; for example, in the exterior impressions of sensible *qualities*, which seem by themselves to be in the understanding; for if we consider the matter well, we shall perceive that we understand nothing more by them, than we do by meer words; and that to work, or to discourse out of them, we must seek into the objects, and their definitions; whereof we learn nothing by those first impressions: for it seemeth, that (for example) hot, or red, or sweet, to a man that first seeth, or feeleth, or tasteeth them, signifieth nothing else, but a thing which maketh such an apprehension in his soul, or such a phantasm in his interior sense; and nevertheless, as yet the man knoweth not that he hath a soul, or an interior sense; nor doth reflect so far as to consider, that this motion passeth by his exterior sense; but his apprehension is immediately carried to the thing without him; and he imagineth that the impression he feeleth, is in the thing he feeleth; and so he that should feel himself heated by a burning glasse, and we not acquainted with the vertue of such a glasse, would think the glasse were hot: yet certainly, his first apprehension is of the motion made in his fanſie, (though he imagineth it elsewhere) which he conceiveth to be the nature of the thing that maketh it. And thus we see that the conversion of the soul, is immediate to a thing without

10.

The difference betwixt the notion of a thing in our understanding, and the impression that correspondeth to the same thing in our fanſie, doth prove the same.

without the man: which also is the effect of her being fixed to *Existence*; for by reason of that, she still apprehendeth every impression as a *thing*.

But now, whether her apprehension doth include the very impression, which is in the sense or in the fanſie, ſo that by its own likenesse it be in the ſoul, or whether the impression in the fanſie maketh a change in the ſoul, which we cannot diſcern in itſelf, but conceive it to be the impression which is in the fanſie, becauſe that impression is at the firſt continually preſent at the ſaid mutation; is more obſcure and hard to diſcover. But when we reflect, that after ſome time, words do ſucceed in lieu of this impression, and do perform the ſame effect as the original impression, in what language ſoever they be uttered, ſo they be underſtood; we may conclude out of this evident ſign, that the impression is in the underſtanding not in its own likeneſſe, but in another ſhape, which we do not diſcover; and which is excited, as well by the name, as by the impression, in a man that is uſed to the names.

Again, in a man that learneth things by himſelf, theſe impressions ſerve for words, and not for things; for ſuch a man never looketh into his fanſie to diſcourſe upon any thing, but only upon the mutation he conceiveth is made in the extern ſenſe: out of which he gathereth by little and little, the nature of the thing, whoſe notion was made at firſt in him by this impression. Out of which it is manifeſt, that our knowledge is as different a thing, from the Phantaſms which beat at the ſouls door, as the thing ſignified is from the ſound of the word, or as the wine in the cellar is from the buſh: and therefore, it is impoſſible that the ſoul (in which that knowledge reſideth, and which indeed is that knowledge) ſhould be a corporeal or bodily thing: ſince of all bodily things, the motions that are made by the ſenſible qualities, arrive neereſt to a ſpirituall nature.

II.
The apprehenſion of negations and privations do prove the ſame,

I remaineth now, that we ſhould argue for the immateriality of the ſoul, out of the extent of our *apprehenſion*: which ſeemeth to be ſo exceſſive, as not to be comprehenſible by the limitations of bodies; and therefore cannot belong unto a body: but becauſe all that needeth to be ſaid in this particular, followeth plainly out of grounds already urged, and that this Point containeth not any notable particularity deſerving mention here; we will not enlarge

large our selves any further upon it, but will passe on to the next line of operations proper to our mind.

Only we may not omit taking notice of the expressions which our mind maketh of *nothing*, or as Logicians term it, of *Negations* and *Privations*: which do argue an admirable power in the soul, and of a quite different strain from all corporal things; and do evidently convince the immateriality of it: for it cannot be doubted, but that the soul knoweth what she meaneth, when she discourseth of *Nothing*. Now if all her knowledge, were nothing else but corporal phantasms, or pictures made by corporal things, how should she come to have a notion of *Nothing*? for since it is most clear, that *something* cannot be like *Nothing*, and that there cannot be a participation of what *is not*; how can we conceive that there should be a similitude made of *Nothing*?

The way therefore that the soul taketh in this operation, is, that comparing two things together, and finding that the one of them is not the other; she reflecteth upon her own action, and dividing in it the thing said, from the saying, she taketh the thing said for a quality, or property, or predicate (as Logicians call it) of that thing which she denyeth to be the other thing; and then she giveth it a positive name, after she hath first made a positive notion, unto which the name may agree: as for example, when the soul considereth a man that hath not the power to see, as soon as she hath to her self pronounced, that he hath not such a power, she taketh the *not power to see*, for a quality of that man; and then giveth the name of *blindness* to that *not power of seeing*; which though of itself it be nothing, yet by being that which satisfieth her act, when she saith that he hath not the power of seeing, it seemeth to be ranked among those things, unto which names are due: for it hath a notion; and the having a notion, is the claim, or merit, or dignity, in vertue whereof things are preferred to names.

Now then, let us enquire how the power of rarity and density, or the multiplication and order of parts, can be raised and refined to the state of being like *nothing*, or of being the similitude of a *negation*; or what operation of rarity or density, can forge out this notion of *blindness*, which we have explicated: and when we finde, it is beyond their reach to compass, we must acknowledge,

ledge, that the soul is another kinde of engine, then all those which are in the storehouse of bodies.

THE SIXTH CHAPTER.

Containing proofs out of our souls operations in knowing or deeming any thing, that she is of a spiritual nature.

I.
The manner
of judging or
deeming by
apprehending
two things to
be identified,
doth prove
the soule to be
immaterial.

Our next consideration shall be, to see what testimony our manner of *Judging*, doth yield us of the nature of the soul : concerning which, three things offer themselves, worthy the reflecting on ; which are, our manner of thinking ; the opposition which frequently occurreth in our thoughts, and the nature of truth and of falshood. As for the first, we may remember how we have shewed, that all judgement or *deeming* is but an apprehension of identification, or something immediately following out of it : and that a settled judgement or *assent of the mind* is as it were a limb, or branch, or graft in our soul ; so that we finde that our perceiving of identification between two things, or our seeing that the one is the other, is that by which our soul encreaseth. Now, because when two things are identified, the one reacheth not farther than the other, it is clear that this increase of the soul is not made by parts, which being added one to another do cause it to be greater : and therefore, since this latter course is the only means of increase in bodies and in quantity, it is as clear that the nature of the soul, is quite different from the nature of all corporeal or Quantitative things.

Again, it is against the nature of identification, to be of parts ; and therefore, they who take quantity to be one thing, and not many things tyed together, do acknowledge that truly there are no parts in it : and this is so rigorously true, that although we speak of two things that in reality are identified one with another, yet if our words be such, as imply that our understanding considereth them as distinct parts, and by abstraction giveth them the nature of parts ; then they are no longer identified, but in good Logick, we ought in this case to deny the one of the other. As for example : though the hand and the foot be the same thing, (as we have declared in our first Treatise) yet because in the name
hand,

hand, there is a secret exclusion of any thing that is not in the definition of a hand, it followeth that in our speech we must say, that a hand is not a foot. Likewise though it be confessed, that the thing which is *rationality* is also *rifibility*; nevertheless, it is a solecism in Logick, to say that *rationality* is *rifibility*, because it is the nature of these abstracted names, to confine their significations to one definition; and the definitions of these two termes are divers. Out of this consideration it followeth clearly, that seeing the nature of parts, is contrary to the nature of identity; and that the soul in her judgements worketh altogether by identity, it is impossible that her operations should consist of parts, or in any sort resemble any proceeding of Quantitative things.

The like will be convinced out of the opposition we fitte in our thoughts. In it we may consider two things: first the generation of it: next, the impossibility of opposites in the soul. To begin with the first: we see that in our speaking, opposition is produced by the addition of this word *Not*: as when we say, *not a man, not a penny, not a word*: and therefore it followeth, that in our soul there is a notion of it, correspondent to the word that expresseth it. Now, seeing that a notion is a thing, and that it is the likenesse of its object, or rather the same with the object: let us cast about, how we should of parts and of quantity, make a *nothing*, or an identification to *not*: and when we finde, that it is ridiculous and absurd to go about it, let us conclude, that the manner of working, which our soul useth, is far different from that which is used in bodies, and among material things.

And if you object, that not only a body, but even any other substance whatsoever (suppose it as spiritual as you will) cannot be either like, or identified to *nothing*; and therefore this argument will as well prove that the soul is not a thing or substance, as that it is not a body: we answer, that it is evident out of what we have already said, that the understanding is not the objects it understandeth, by way of similitude, but by a higher means; which we have shewed to be by way of *Respects*. Now then, the respect which the thing hath to another thing, by not having such a respect unto it, as a third thing formerly considered hath thereunto, may be expressed in way of *Respects*, though it cannot in way of similitude: and so our understanding is able to express, what

2.

The same is proved by the manner of apprehending opposition in a negative judgment.

what neither out fansie, nor any corporeal thing can arrive to the expression of: as when first we finde, that one man hath a respect to the wall, which we call the power of seeing it, if afterwards we finde that another man hath a respect unto the wall of impotence, that he cannot see it, this second respect he understanding hath a power to expresse as well as the first: as we have touched above.

3.
That things in themselves opposite to one another having no opposition in the soul, doth prove the same.

As for the opposition that occurreth in our thoughts, we may consider it of two kindes: the one is of the things or objects that come into our thoughts or into our soul and this is not properly an opposition in the soul; for although the things be opposite by their own nature in themselves, yet they do not exercise their opposition in the soul: nay, though the opposition be even in the soul it self, if the soul with this opposition, be considered as an object, it maketh no opposition in the soul; for so you may consider your soul learned and unlearned, ignorant & knowing, good and bad, and the like: all which are oppositions in a soul supposed to be so qualified, but are no oppositions in a soul that considereth them: no more than fire and water, heavy things and light, white and black, being and not being, an affirmative proposition and its negative, and the like: all which are in themselves so contrary and opposite to one another, that they cannot consist together in one subject; they have an impossibility among themselves, wheresoever the one of them is, by its very entrance it driveth out its opposite: and yet in the soul they agree together without reluctance: she knoweth and considereth and weigheth both sides of the scale at the same time, and ballanceth them evenly one against another: for unless both the opposites were in the same instant in the same comparing power, that power could not by one act whose beginning implyeth its ending, judge the difference and opposition of them: as when we say *black is contrary to white, or darknesse is the want of light*, we pronounce one common *not being* of both extremes.

We may then boldly conclude, that since no body whatsoever can entertain at the same time, and in the same place, these quarrelling Antagonists, but that by their conflict, they presently destroy one another, and peradventure the body too, into which they presse for entrance, and the entire possession of which each of them striveth for; (those of them I mean, that are proportioned

tioned to the reception of bodies) and that the soul imbibeth them together without any difficulty or contrast, and preserveth them alwaies friends even in the face of one another, and lodgeth them together in the same bed; and that (in a word) these opposite things do enjoy an admirable and unknown manner of *Being* in the soul, and which hath no parallel nor argument in bodily things: we may (I say) boldly conclude, that the soul itself, in which all these are, is of a nature, and hath a manner of *Being* altogether unlike the nature of bodies, and their manner of *Being*.

Out of this agreeing of all objects in the soul, and their having no opposition there, even whiles she knoweth the opposition that is between them in themselves, there followeth another consideration, of no lesse importance: which is, that the amplitude of our soul in respect of knowledge, is absolutely infinite; that is to say, she is capable of knowing at the same time objects without end or measure. For the explicating whereof, we are to consider, that the latter conclusions, which the soul gaineth knowledge of, do hang to the former by identification, or by the souls seeing that two notions are identified, because they are identified to a third, as is before expressed; and the first principles which seem to be immediately joyned unto the soul, have the identity of their terms plain and evident, even in the very terms themselves. Nay, if we insist further, we shall finde that the first truths must have an identification to the very soul itself; for it being evident that truth or falsehood is not in the soul, but so far forth as she doth apply her self to the external object, or to the existence of things in themselves; and that we finde that the souls knowing with evidence that any thing *is* or *hath being*, implyeth her knowing that her self *is*; (for she cannot know that a thing seemeth so to her, or maketh such an impression in her, without knowing that her self *is*; though peradventure she may not know what her self is, but taketh her self to be no other thing than the body of the man in which she is) it is evident that the first truths which enter into the soul, to wit, that this or that seemeth so or so unto her, (and these truthe no sceptick ever doubted of) are identified with the soul it self; seeing that an

4.
That the first truths are identified to the soul.

Ecc object

object seeming to be such or such, is nothing else, but the soul is so qualified.

And in this we finde, that the certainty of the first *Principles*, as for example of this Proposition, *That the whole is bigger than the Part*, will depend in a particular soul of her certainty of her own *Being*: for although this Proposition would have a necessity in the very connexion of the terms, notwithstanding there were not in nature any *whole* or *Part*; yet this necessity would not be a necessity of *Existence* or of *Being* in the object, but a necessity of connexion, as it were of two parts of the soul: and so, if verity and falsity be not perfectly in the soul, but in the comparison to actual existence, the soul would not be perfectly true, or (to say more properly) would not have the perfection of truth in her, by having or knowing this Proposition, unless she were certain, that there were existent, an object of this Proposition: of which (as we have said) she cannot be certain, without being certain of her own *Being*; so that in effect, the identification of other things among themselves, by which such things are known, doth come at the last to be retrived in the existence of the soul it self, and to be in the soul, by the identification of those other things unto her self.

5. Now then to proceed to the proof of our proposed conclusion, it is clear, that the adding of one thing to another, doth out-
 That the soul hath an infinite capacity, and consequently is immaterial.
 of the force of this addition, perfect the thing unto which the addition is made, if the advenient thing be added in such way, as the former is apt to receive it: but it is evident, that the soul is made fit by former Propositions, to be identified to latter ones; for we see that the former ones draw on, and inferre the latter ones: and therefore it followeth, that the more is added to the soul, the greater is her aptitude to have more, or to be more encreased: and consequently, that the more is added unto her, the more may still be added; and the more capable and more earnest she is, to have more. Wherefore it cannot be denied, but that since in the nature of the objects there is no impediment to hinder their being together in the soul, (as we have proved a little above) and that in her by receiving new objects into her, there is a continual encrease of capacity to receive more; she hath an amplitude to knowledge absolutely

absolutely infinite, in such a manner as we have above expressed.

Now to apply to our purpose what we have gathered by this discourse, it is clear, that these two conditions of *one thing not driving out another*, and of *infinity of accessions*, do openly disclaim from quantity, and from matter; for we see that what hath Quantity, or is a body, cannot admit a new thing into it, unless some other thing do first go out of it, to make room for the advenient one: and as for infinitude, it breedeth a sea of contradictions, if it be but thought of in Quantity: and therefore we may conclude, that the soul, unto whom these two conditions do belong, is not quantitative or corporeal, but immaterial, and of a spiritual nature.

The second kinde of opposition, that occureth in our thoughts, or in our soul, is of *Contradictory Propositions*: it hath its origine in the opposition of *Being* to not *Being*: and is when a thing is identified unto the soul, in such sort as we have said, that a *Judgment* or *Deeming* maketh the object become as it were a limb, or part of the soul: and because the conflict of two such Propositions, if they were together in the soul, would make her be something contrary to the nature of *Being* (if any thing can be contrary to *Being*) which in the schools they call *ens & non ens*; the impossibility of her admitting into her self two such Propositions together, doth testifie her firm cleaving and her fixedness to *Being*: and so doth confirm and bring new evidence to that argument for the souls spirituality, which in the first Chapter of this part, we drew from the nature of *Being*.

As for truth and falsehood, they spring from the same root as the last; as being qualities consequent to the opposition of affirmative and negative Propositions; whereof if the one be true, the other must necessarily be false: and therefore, we need not spend time in setting down any particular considerations of these; since what we have said of the other, is applyable unto them: but it is sufficient, that we thus note them, to give the Reader occasion to reflect upon them.

Among Propositions, there are some which Logicians do term *How Propositions of eternal Truth*: and out of these, there are ingenious men, who imagine that the immortality of the soul may be immediately deduced. Herein they rove not quite from the mark; though

Ecc 2

withall the soule

6.

That the opposition of contradictory Propositions in the Soul doth prove her immateriality.

7.

How Propositions of eternal truth, do prove the immateriality of the soule

withall I must needs say, they do not directly hit it. To understand the utmost that may be inferred out of such Propositions, we may note two conditions in them: the first is, that generally these Propositions are universal ones; and thereby have that force to convince the spirituality of the soul, which we have explicated and shewed to belong unto universal terms: the second is, that in these Propositions, there is a necessity of connexion between their terms; such an one, or at the least very like thereunto, as we explicated in those Propositions, which bear their evidence plain in their very termes. And out of this we may draw another argument for the spirituality of the soul: for we see that all corporerall agents and patients, are defectible and contingent; that is to say, sometimes, or if (if you will) most times, they attain their effect; but withall, sometimes (be it never so seldom) they misse of it: and accordingly, it happeneth sometimes that our eyes, our ears, our touch, and the rest of our senses are deceived; though for the most part, they give us true informations of what they converse with: but these Propositions of eternal verity do never fail: they have in themselves an indefectibility insuperable; and consequently, they give evidence that the souls nature is of a higher degree of constancy and certainty, than what falleth within the compass: of bodies: and is of a nobler and different strain, from all corporall things: for this certainty is entailed upon such Propositions by the force of *Being*; which is the proper object of the soul: and they have their *Being*, as limbs and parts of the soul.

As for the term of *Eternal verity*, it is not to be taken positively, as if these Propositions, or their objects, had any true eternity or perseverance, without beginning or ending: but only negatively; that is, that there can be no time, in which they are false: and therefore, we cannot out of their having such a kinde of Eternity belonging to them, argue a capacity of infinite time or duration in our soul that comprehendeth them.

THE SEVENTH CHAPTER.

*That our discoursing doth prove our soul to be
incorporeal.*

HAVING thus run over those proofs for the immateriality of our soul, which arise out of her manner of working when she judgeth; in the next place, we are to enquire what others, her manner of discoursing will afford us. We are sure, that since our discourse is composed of judgements, and of single apprehensions, it cannot choose but furnish us with all those pregnant arguments, that we drew from them. But that will not serve our turn: we look after new evidence: and we shall see it will give it us with full hands. It consisteth in this: that when we discourse, we may easily perceive there is more at one time in our minde, than we can discover to be in our fantasie; for we finde, that in our fantasie, as one Proposition cometh, another is gone: and although they that are gone, seem to be ready at a call, yet they are not in presence; as being things which consist in motion, and that require place; and therefore the one justleth the other out of the place it possessed. But if it faded in like manner in our inward soul, we could never attain unto knowledge: for it is manifest, that our soul is not assured of a conclusion, but by her seeing the premisses: if then the premisses be taken away, the conclusion that resteth upon them, falleth to the ground: but they are taken away, if they be out of our mind: therefore, when our understanding yeeldeth its assent to a conclusion, it must of necessity have the premisses still in it.

But we must not rest here; this consideration will carry us on a wondrous deal farther: we know, that whoso goeth to frame a new demonstration in any subject, must be certain he taketh nothing contrary to what he hath learned in many books: likewise, that who will make a Latine Verse, or readeth a Poem, knoweth there is nothing in all that Poem contrary to his Prosodia: do we not then manifestly perceive a certain remainder of all these in his soul? The like is in all arts: in which he

Ecc 3

that

1.

That in discoursing the soul containeth more in it at the same time, than is in the fantasie, which proveth her to be immaterial.

that goeth about any work according to art, sheweth he hath in his head all the rules of that art, though he do not distinctly remember them, or call them to minde whiles he worketh: for if he have them not, how doth he work by them? Since then it is clear that he thinketh not of them at that time, it is as clear, that more is in the soul at one time, than is in his fantasie, or than can be there by material bodies (which we have shewed is the way, whereby all things come into the fantasie) although it be the nimblest and the subtilest Agent of all corporeal things whatsoever.

2.
That the nature of discourse doth prove the soul to be ordered to infinite knowledge, and consequently to be immaterial.

Another consideration whereby to evince the immateriality of the soul, concerneth the proceeding of syllogisms by links, fastned one to another: whence we may take notice, that every one of them is a step to another: and consequently, it is manifest, that according to the nature of the soul, they must be altogether in her: since, if any one were absent, all the rest that followed and depended upon that one, would have no grounding, nor fixedness in the soul. Now if to this we adde, that what is to be known, is absolutely and liquidly infinite, there cannot be brought or expected a more pregnant and home-witness of our souls spirituality: it following out of these grounds; that the soul by its nature, is not onely capable of, but is expressly ordered to an infinite knowledge of infinite objects altogether; for these two, *finite* and *infinite* science, are so vastly different from one another, that if the same subject be capable of both, it must of necessity be ordered to infinite, as to its chiefest act and end: and thus out of *capacity* in this subject, *its being ordered* is well inferred; though in other matters peradventure the consequence may not be good. And accordingly who looketh into *Geometry*, *Arithmetick*, *Logick*, or even *nature* it self, will evidently see that the objects of knowledge, are every way, and in every science, multipliable without end.

3.
That the most natural objects of the soul are immaterial, and consequently the soul her self is such.

Neither ought this to be neglected, that a great part of the souls objects, and indeed of those that are most natural to her, is above the capacity, and out of the reach of material things. All Metaphysicks abstract from quantity: the investigation of God, of Angels, of the soule it self; either concludeth immateriality, or at the least worketh about it.

What

What shall I say of Logical notions, of those which are called the *second intentions*; about which there is so much business both in the schools and in the world? It is sufficient that we have already expressed, how all our notions are *respective*. But in particular the motives of humane actions are very abstracted considerations: as for example, hope of things to come, memory of things passed, virtue, vice, honour, shame, and the like. To these let us add, that when we teach or explicate any thing to ignorant persons, we must frame our own apprehensions to their capacity, and we must speak such things as they may comprehend: which capacity or extent of comprehension we cannot see nor perceive by any sense, but we judge it meerly by our Reason, and by our Understanding. Wherefore, seeing that our operation is mainly and chiefly on and by such motives, as are not liable to material principles and compositions, it is evident, that the spring-head from whence such an operation floweth, must also be immaterial and incorporeal.

I am not ignorant, that this argument useth to be answered by urging, that the soul likewise knoweth *Deafness*, *Dumbness*, *Blindness*, and such other notions of *Nothings*; and yet is not from thence inferred to be *nothing*; it conceiveth God and Eternity; and yet it is neither from it self, as God is, nor eternal. In like manner (say they) it may know incorporeal things, and yet not be therefore it self incorporeal. To this I reply, first wishing them not to mistake me, but to give my argument its full force and weight: for there is a very great difference between the knowing of a thing, in a strained, toilsom, and confused manner, and the having a thing for its ordinary matter and subject of negotiation: this argueth connaturality between the soul, and what it is in such sort conversant about; but that doth not. Now what is inferred out of whole sciences and arts, concerneth a main stock of the souls business, and not some extraordinary vertue or powers she hath.

But to come up to close to the answer: I say, that if we being thoroughly acquainted with material things, can finde that it is not in the possibility of any such to be the likeness of an immaterial thing; and from thence do infer that our soul, for being

fraught with immaterial notions, is not material; our conclusion is well collected, and a very good one; for the premises out of which we do gather it, are within our kenning; and therefore if there were any defect in the consequence, we should easily perceive it. Whence it appeareth clearly, that there is no parity between the deduction of our conclusion, and that other which the objection urgeth, that our soul, because it can know eternal things, is also eternal; for eternity is a thing beyond our comprehension: and therefore it ought not to be expected at our hands, that we should be able to give an account where the brack is. And to say the truth, if *knowledge* be taken properly, we do not know eternity; however by supernatural helps we may come to know it; but in that case, the helps are likely to be proportionable to the effect. Neither are negations properly known, seeing there is nothing to be known of them. And thus we see that these objections do proceed from the equivocation of the word *knowledge*; sometimes used properly, other times applied abusively.

THE EIGHTH CHAPTER.

Containing proofs out of our manner of proceeding to action, that our soul is incorporeal.

I. **I** Doubt not but what we have already said, hath sufficiently convinced our souls being immaterial, unto whomsoever being a power is able to penetrate the force of the arguments we have brought to order things for proof thereof, and will take the pains to consider them proverbs her to be immaterial. duly: (which must be done, by serious and continued reflection, and not by cursary reading, or by interrupted attempts) yet since we have still a whole field of proofs untouched, and that in so important a matter, no evidence can be too clear, nor any pains be accounted lost, that may redouble the light, although it shine already bright enough to discern what we seek, we will make up the concert of unanimous testimonies to this already established truth, by adding those arguments we shall collect out of the manner of our souls proceeding to action, unto

unto the others we have drawn from our observations unto her apprehensions, her judgements, and her discourses.

Looking then into this matter: the first consideration we meet withall, is, that our understanding is in her own nature an *orderer*; and that her proper work is to rank and put things in order: for if we reflect upon the works and arts of men, as, a good life, a common-wealth; an army, a house, a garden, all artefacts; what are they, but compositions of well-ordered parts? And in every kind, we see that he is the Master, and the Architect, and is accounted the wisest, and to have the best understanding, who can best, or most, or farther than his fellows, set things in order. If then to this we joyn, that Quantity is a thing whose nature consisteth in a capacity of having parts and multitude, and consequently is the subject of ordering and ranking; doth it not evidently follow, that our soul, compared to the whole mass of bodies, and to the very nature of corporeity or quantity, is as a proper agent to its proper matter to work upon? Which if it be, it must necessarily be of a nobler strain, and of a different and higher nature than it; and consequently, cannot be a body, or be composed of Quantity: for had it matter in it self, what it expecteth and requireth from the agent, it would not need the agents help, but of it self it were fit to be an Agent. Wherefore if the nature of corporeity, or of body, in its full latitude, be *to be ordered*, it followeth that the thing whose nature is to be an *orderer*, must as it is such, be not a body, but of a superiour nature, and exceeding a Body: which we express by calling it a *spiritual thing*.

Well then, if the soul be an *orderer*, two things belong necessarily unto her: The one is, that she have this order within her self; the other is, that she have power to communicate it unto such things, as are to be ordered. The first she hath by science, of which enough already hath been said towards proving our intent. Next, that her nature is communicative of this order, is evident out of her action and manner of working. But whether of her self she be thus communicative, or be so by her conjunction to the body she informeth, appeareth not from thence. But where Experience falleth short, Reason supplieth, and sheweth us that of her own nature she is communicative of order; for

2. That the souls being able to move without being moved, doth prove her to be immaterial.

for seeing that her action is an *ordering*, and that in this line there are but two sorts of things in the world, namely, such as do order and such as are to be ordered; it is manifest, that the action must by nature and in the universal consideration of it, begin from the *orderer* (in whom order hath its life and subsistence) and not from that which is to receive it: then, since *ordering* is motion, it followeth evidently, that the soul is a mover and a beginner of motion.

But since we may conceive two sorts of movers; the one, when the agent is moved to move; the other, when of it self it beginneth the motion without being moved; we are to enquire, unto which of these two the soul belongeth. But to apprehend the question rightly, we will illustrate it by an example: let us suppose that some action is fit to begin at ten of the clock: now we may imagine an agent to begin this action in two different manners; the one, That the clock striking ten, breedeth or stirreth somewhat in him, from whence this action followeth; The other manner is, that the agent may of his own nature, have such an actual comprehension or decurrence of time within himself, as that without receiving any warning from abroad, but as though he moved and ordered the clock as well as his own instruments, he may of himself be fit and ready, just at that hour to begin that action; not as if the clock told him what hour it is, but as if he by governing the clock, made that hour to be, as well as he causeth the action to begin at that hour. In the first of these manners, the agent is moved to move; but in the second, he moveth of himself, without being moved by any thing else. And in this second way, our soul of her own nature communiceth her self to quantitative things, and giveth them motion: which followeth out of what we have already proved, that a soul, in her own nature, is the subject of an infinite knowledge, and therefore is capable of having such a general comprehension, as well of time, and of the course of all other things, as of the particular action she is to do; and consequently, standeth not in need of a Monitor without her, to direct her when to begin.

If then it be an imprevaricable law with all bodies, that none whatsoever can move, unless it be moved by another;

it

it followeth, that the soul which moveth, without being stirred or excited by any thing else, is of a higher race than they; and consequently is immaterial and void of quantity. But let me not be mistaken in what I come from saying; as though my meaning were, that the soul exerciseth this way of moving her self, and of ordering her actions; whiles she is in the body: for how can she, seeing she is never endued with compleat knowledge requisite for any action; never fully comprehending all the circumstances of it? But what I intend, is that the nature of the soul, considered in it self, is such, as hath a capacity, and may reach to this manner of working, (whence I infer, that she is not a body but a spirit) without determining, whether she work thus in the body, or out of it: that enquiry belongeth not to this place; it will follow by and by.

But for the present, having considered unto what kind of working, the nature of the soul in abstract, is capable of attaining; we will conclude this Chapter with reflecting upon those actions of hers, which fall daily under our remark, as being exercised in the body. In all of them we may observe, that she proceedeth with a certain universality and indifferency, beyond the practice of all other creatures whatsoever. For example, if a man be spoken to, or asked of a hundred several things, that he never thought of before in all his life, he will immediately shape pertinent replies, to all that is said, and return fitting answers to every question: As, *Whither such a man goeth? How long this staff is? What colour that mans clothes are of? &c.* To all which, and to as many things more as you will (so they be within the compass of his knowledge) he straight answereth differently, and to the purpose. Whence it is manifest, that his answers do not proceed upon set gimals or strings, whereof one being struck, it moveth the rest in a set order, (which we have shewed, is the course in all actions done by beasts) but out of a principle within him, which of it self is indifferent to all things; and therefore can readily apply it self to the answer, according as by the question it is moved: and the like may be observed in his actions; which he varieth according to the occasion presented.

5.
That the souls proceeding to action with an universality, & indifferency, doth prove the same.

I remember how Sir *Philip Sidney* (the Phoenix of the age he lived in, and the glory of our Nation, and the pattern to posterity of a compleat, a gallant, and a perfect Gentleman) aptly calleth our hands, the instruments of instruments; from *Aristotle*, who termeth them *Organa organorum*, or universal instruments, fitly moulded to be employed in any service; whereas nature hath to all other creatures appropriated their instruments to determinate actions, but to man, she hath (in these) given such, as might be applied to any kinde of work whatsoever: and accordingly we see, that the same kind of bird, still buildeth her nest, and breedeth her young ones, in the same way, without any the least variance at all: but men do build their houses as they please, sometimes upon hills, sometimes in vales, sometimes under the earth, and sometimes upon the tops of trees: and the manners of breeding or instructing their children, are as divers, as the customs of Nations and Towns: and in all other actions, our Masters note it for a property peculiar to man, that he useth to arrive unto the same end by divers means, as to transport our selves unto some place we would go unto, either by water, or by horse, or by coach, or by litter, as we please: whereas we see no such variety in like actions of other living creatures.

All which being so, we may conclude, that the souls proceeding either to answer, or to action, argueth clearly that she hath within her self such an indifferency, as is joyned with a means to determine this indifferency: the contrary whereof we see in all corporeal engines; for they have every step in the whole course of their ways, chalked out unto them, by their very framing (as hath been amply declared in the first Treatise) and have the determination of their work, from end to end set down, and given them by their artificer and maker: and therefore it is most evident, that the soul cannot be a thing composed or framed of material and quantitative parts, seeing she hath not her ways set down unto her, but frameth them of her self, according to the accidents that occur:

4.
That the quiet
proceeding of
reason doth
provethe same

The same nature of the soul, discovereth it self in the quiet proceeding of *Reason*, when it worketh with greatest strength and vigour; as well knowing, that its efficaciousness consisteth

not

not in the multitude of parts, which *Passion* breedeth, but in the well ordering of those it already hath under its command. Whereas the strength of *Quantity*, and the encrease of its strength, consisteth in the multitude of its parts; as will evidently appear to whom shall consider this point deeply.

Thus we have in a summary manner gone through all the operations of the soul, which in the beginning of this latter Treatise, we heaped together as material, wherewith to raise an immaterial and spiritual building. Neither, I hope, will our Reader be offended with us, for being more succinct and concise in all our discourse concerning our soul, than where we delivered the doctrine of Bodies: for the difficultness of this subject, and the nicety required to the expressing our conceptions concerning it, wherein (as the proverb is) a hair is to be cloven, would not allow us that liberty of ranging about, as when we treated of Bodies. What occurreth among them, may be illustrated by examples within their own orb, and of their own pitch; but to display the operations of a soul, we can finde no instances that are able to reach them; they would rather embroil and darken them: for the exact propriety of words, must be strictly and rigorously observed in them: and the Reader shall penetrate more into the nature and depth of them, by serious meditation and reflection upon the hints we have here given, (efficacious enough, I hope, to excite those thoughts he should have for this purpose, and to steer them the right way) than by much and voluminous reading, or by hearing long and polished discourses of this subject:

For my part, if what I have here said, should to any man appear not sufficient to convince that our soul is of a spiritual and far different nature, from all such things as in our first Treatise we have discoursed upon, and taken for the heads and most general kindes of Bodies, (unto which all other particular ones, and their motions may be reduced) I shall become a suter to him, in entreating him to take this subject into his handling, where it beginneth to be unwieldy for mine, and to declare unto us, upon the principles we have settled in the first Treatise, and upon considering the nature of a body, (which is the first of all our notions) how these particulars we have reflected upon in

mans

5.

A conclusion of what hath been said hitherto in this second treatise.

mans actions, can be drawn out of them; for I can finde no possible means to linke them together: a vast and impenetrable Ocean lyeth between the discoveries we have made on each side of its shores, which forbiddeth all commerce between them; at the least, on the dark bodies side, which hath not wings to soar into the region of *Intellectual* light. By those principles, we have traced out the course and progresse of all operations belonging to sense; and how beasts do or may perform all their actions, even to their most refined and subtilest operations: but beyond them, we have not been able to carry these grounds, nor they us. Let him then take the pains to shew us, by what figures, by what first qualities, by what mixtion of rare and dense parts, an universal apprehension, an evident judgement, a legitimate consequence is made: and so of the like; as, of a mans determination of himself to answer pertinently any question; of his choosing this way before that, &c. Which if he can do (as I am sure he cannot) I shall allow it to be reason, and not obstinacy, that worketh in his minde, and carryeth him against our doctrine: but if he cannot, and that there is no apparence nor possibility (as indeed there is not) that these actions can be effected by the ordering of material parts, and yet he will be still unsatisfied, without being able to tell why, (for he will be unwilling to acknowledge, that these abstracted speculations, do not sink in to him, and that nothing can convince him, but what his senses may be judges of, and that he may handle, and turn on every side like a brick or a tile) and will be still importune with cavillous scruples, and wild doubts, that in truth, and at the bottom do signifie nothing, we will leave him to meditate at his leisure upon what we have said; whiles we proceed on to what followeth out of this great principle, *That our soul is incorporeal and spiritual.*

THE NINTH CHAPTER.

That our Soul is a Substance, and Immortal.

HAVING concluded that our Soul is immaterial and indivisible; to proceed one step farther, it cannot be denyed, but that it is either a substance or an accident; if the latter, it must be of the nature of the substance whose accident it is; for so we see all accidents are: but in man when his soul is excluded, there is no spiritual substance at all, whereof we have any notice: and therefore if it be an accident, it must be a corporeal accident, or some accident of a body; as some figure, temperature, harmony, or the like: and consequently, it must be divisible: but this is contrary to what is proved in the former Chapters: and therefore it cannot be a corporeal accident. Neither can it be a spirituall accident; for unto what spirituall substance should it belong, when as nothing in man can be suspected to be spirituall, but itself? Seeing then that it can be no accident, a substance it must be, and must have its *Existence* or *Being* in it self.

Here we have pass'd the Rubicon of experimental knowledge: we are now out of the bounds that experience hath any jurisdiction over: and from henceforth, we must in all our searches and conclusions rely onely upon the single evidence of Reason. And even this last conclusion we have been fain to deduce out of the force of abstracted reasoning upon what we had gathered before; not by immediate reflection upon some action we observe proceeding from a man: yet withall, nature flasheth out by a direct beam, some little glimmering of the verity of it, to the eye of Reason that is within us: for as when we see a clock move, or see any thing that goeth by many wheels, if we mark that there are two contrary motions, in two divers parts of it, we cannot think that those contrary motions, do belong to one and the same continued body, but shall presently conclude, that there must be in that engine two severall bodies compacted together; so in man, though his body be the first mover that appeareth unto us, yet seeing that in his actions, some effects do shew themselves, which

1.

That Mans Soul is a substance.

2.

That Man is compounded of some other substance besides his body.

which it is impossible should proceed from a body, it is evident, that in him there is some other thing besides that one which we see: and consequently we may conclude, that he is composed of a body and of somewhat else that is not a body: which *somewhat else*, being the spring from whence those actions flow, that are of a different strain from them that are derived from the body, must necessarily be a spiritual substance.

3. But whiles we are examining, how far our present considerations, and short discourses may carry us, as it were experimentally to confirm this truth, we must not omit what *Avicenna* in his book *De Anima & Almahad*, and *Monsieur des Cartes* in his Method, do presse upon the same occasion. Thus they say, or to like purpose: If I cast with my self, who I am that walk, or speak, or think, or order any thing; my reason will answer me, that although my legs or tongue were gone, and that I could no longer walk or speak, yet were not I gone, and I should know and see with my understanding, that I were still the very same thing, the same *Ego* as before. The same as of my tongue or legs, would reason tell me of my eyes, my ears, my smelling, tasting, and feeling, either all of them together, or every one of them single, that were they all gone, still should I remain: As when in a dream, (where I use none of all these) I both am, and know my self to be. Reason will tell me also, that although I were not nourished, so I were not wasted, (which for the drift of the argument may be supposed) yet still I should continue in *being*. Whence it would appear, that my heart, liver, lungs, kidneys, stomach, mouth, and what other parts of me soever, that serve for the nourishment of my body, might be severed from me, and yet I remain what I am. Nay, if all the beautiful and airy fantasms, which fly about so nimbly in our brain, be nothing else but signs unto in our soul, of what it is without us; it is evident, that though peradventure she would not without their service, exercise that which by error we mis-name *Thinking*; yet the very same soul and thinker might be without them all: and consequently, without brain also; seeing that our brain is but the play-house and scene, where all these facry marks are acted: so that in conclusion Reason assureth us, that when all body is abstracted in us, there still remaineth a substance, a thinker, an *Ego*, or *I*, that in it self is no whit diminished, by being (as I may say) stripped out of the case it was inclosed in. And

And now I hope the intelligent Reader will conceive I have performed my promise, and have shewed the Soul of man to be an *Immortal substance* : for since it is a *substance*, it hath a *Being* ; and since it is immaterial substance, it hath a *Being* of its own force ; without needing a consort body, to help it to sustain its *Existence* : for to be a substance, is to be the subject of *Existence* ; and consequently, to be an immaterial substance, is to be a subject capable of *Existence*, without the help of matter or of *Quantity*. It cannot therefore be required of me, to use any further industry, to prove such a soul to be immortal : but who will contradict her being so, is obliged to shew that she is mortal : for it followeth in reason, that she will keep her *being*, unless by some force she be bereaved of it ; it being a rule, that whosoever putteth a thing to be, is not bound, for the continuation of that things being, to prove that it is not changed : but on the other side, he that avereth it is changed, is bound to bring in his evidence of a sufficient cause to change it : for to have a thing remain, is Nature's own dictamen, and followeth out of the causes which gave it *Being* ; but to make an alteration, supposeth a change in the causes, and therefore the obligation of proof lyeth on that side.

Nevertheless, to give satisfaction to those, who are earnest to see every article positively proved, we will make that part too our *Province*. Let us then remember, that *Immortality* signifieth a negation, or a not having of *Mortality* : and that a positive term, is required to expresse a change by ; since Nature teacheth us, that whatsoever is, will remain with the *Being* it hath, unless it be forced out of it : if then we shew, that Mans soul hath not those grounds in her, which maketh all things we see, to be mortal ; we must be allowed to have acquitted our selves of the charge, of proving her *Immortal*. For this end let us look round about us, and inquire of all the things we meet with, by what means they are changed, and come to a period, and are no more. The pure Elements will tell you, that they have their Change, by rarefaction and condensation, and no otherwise : mixed bodies, by alteration of their mixture : small bodies, by the activity of the Elements working upon them ; and by the means of rare-

4.

Two other arguments to prove the same: one positive, the other negative.

5.

The same is proved because the soul cannot be obnoxious to the cause of mortality.

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faction and condensation entering into their very constitution, and breeding another temperament, by separation of some of their parts, and in their stead mingling others. Plants, and Trees and other living Creatures will tell you, that their nourishment, being insinuated through their whole bodies, by subtile pores, and blinde passages, if they either be stoped by any accident, or else be filled with bad nourishment, the mixture of the whole faileth of itself, and they come to die. Those things which are violently destroyed, we see are made away, for the most part by division; so fire by division destroyeth all that cometh in its way; so living Creatures are destroyed, by their parting of their blood from their flesh, or of one member from another, or by the evaporation or extinction of their natural heat. In fine, we are sure that all things, which within our knowledge lose their *Being*, do so by reason of their Quantity; which by division, or by rarefaction, and compression, gaineth some new temperature, that doth not consist with their former temper. After these premisses, I need say no more: the conclusion displayeth it self readily and plainly, without any further trouble; for if our labour hath been hitherto, to shew that our soul is indivisible, and that her operations are such as admit not quantitative parts in her; it is clear, that she cannot be mortal, by any of those waies whereby we see things round about us to perish.

The like argument we may frame out of local motion; for seeing that all the alterative actions we are acquainted withall, be performed by local motion (as is delivered, both in grosse, and by detail, in our first Treatise) and that *Aristotle*, and all understanding Philosophers do agree, there can be no local motion in an indivisible thing (the reason whereof is evident, to whomsoever reflecteth upon the nature of *Place*, and of *local motion*) it is manifest, that there can be no motion to hurt the soul, since she is concluded to be *indivisible*.

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The same is
proved be-
cause the soul
hath no con-
trary.

The common argument likewise used in this matter, amounteth to the same effect: to wit, that since things are destroyed only by their contraries; that thing which hath no contrary, is not subject to destruction: (which Principle both Reason and experience, do every where confirme:) but a humane soul is not subject to contrariety: and therefore such an one cannot be destroyed.

stroyed. The truth of the assumption, may be known two waies : first, because all the contrarieties that are found within our cognisance, do rise out of the primary opposition of *Rarity*, and *Density* ; from which the soul being absolutely free, she likewise is so, from all that groweth out of that rout : and secondly, we may be sure, that our soul can receive no harm from contrariety ; since all contraries are so far from hurting her, as contrarywise, the one helpeth her in the contemplation of the other : and as for contradiction in thoughts, which at different times our soul is capable of admitting, experience teacheth us, that such thoughts do change in her, without any prejudice to her substance, they being accidents, and having their contrariety only betwixt themselves within her, but no opposition at all to her ; which only is the contrariety that may have power to harm her : and therefore, whethersoever of such contrary thoughts be in the soul, pertaineth no more to her subsistence, than it doth to the subsistence of a body, whether it be here or there, on the right hand, or on the left.

And thus I conceive my taske is performed ; and that I am discharged of my undertaking to shew the souls *Immortality*, which importeth no more, than to shew, that the causes of other things mortality, do not reach her. Yet being well perswaded, that my Reader will not be offended with the addition of any new light, in this dark subject ; I will strive to discover (if it be possible) some positive proof, or guesse, out of the property and nature of the soul it selfe, why she must remain, and enjoy another life after this. To this end let us cast our eye back, upon what hath been already said, concerning her nature. We found that truth is the natural perfection of Mans soul ; and that she cannot be assured of truth naturally, otherwise than by evidence : and therefore it is manifest, that evidence of truth, is the full compleat perfection, at which the Soul doth aim. We found also, that the soul is capable of an absolute infinity of truth or evidence. To these two, we will adde only one thing more, which of it self is past question, and therefore needeth no proof ; and then we will deduce our conclusion, and this is ; that in a man his soul is a far nobler, and perfecter part of him, than his body : and therefore, by the rules of Nature and of Wisdom, his body was made for his soul, and not his soul finally for his body.

7.
The same is proved from the end for which the soul was created.

¶ If 2

These

These grounds being thus layed, let us examine, whether our soul doth in this life arrive to the end she was ordained for, or no: and if she do not, then it must follow of necessity, that our body was made but for a passage, by which our soul should be ferried over into that state, where she is to attain unto that end for which her nature is framed and fitted: the great skill, and artifice of Nature, shewing and assuring us that she never faileth of compassing her end, even in her meanest works: and therefore without doubt would not break her course in her greatest, wherefore *man* is absolutely the head and chief, among all those that we are acquainted with now, what the end is, unto which our soul doth aim, is evident; since the perfection of every thing, is the *end* for which it is made, the perfection then, and end of the soul being *evidence*, and she being capable of infinite *evidence*; let us enquire, whether in this life she may compass it or no. To determine this question, let us compare infinite *evidence*, to that *evidence*, which the greatest and most knowing man that ever lived, hath acquired by the work of Nature alone; or to the evidence, which by aim we may imagine is possible ever to happen unto any one man to arrive unto: and balancing them well together, let us judge whether all that any man can know here, is not in respect of what a mans soul is capable of, to be stiled as nothing, and deserveth not the name of *evidence*, nor to be accounted of that nature: and if our sentence do conclude upon this, let us acknowledge that our soul arriveth not to her perfection, nor enjoyeth her end in this world, and therefore, must have infallibly another habitation in the next world, unto which Nature doth intend her. Experience teacheth us, that we cannot fully comprehend any one of Natures works: and those Philosophers, who in a disciplinable way search into Nature, (and therefore are called Mathematicians) after they have written large volumes of some very slender subject, do ever finde, that they have left untouched, an endless abyss of knowledge, for whomsoever shall please to build upon their foundations, and that they can never arrive near saying all that may be said of that subject, though they have said never so much of it. We may not then make difficulty to believe, that the wisest and learnedst men in the world, have reason to profess with the father of Philosophers, that indeed they know nothing. And if so, how far are they

they from that happiness and perfection, which consisteth in knowing all things? Of which full sea, we nevertheless finde even in this low ebbe, that our soul is a channel capable, and is framed a fit vessel and instrument to receive it, when the tide shall come in upon it, which we are sure it cannot do, until the banks of our body which hinder it, be broken down.

This last consideration, without doubt, hath added no small corroboration to our former proofs; which are so numerous and so clear, as peradventure it may appear superfluous to say any more to this point; since one convincing argument establisheth the verity of a conclusion, as efficaciously as a hundred, and therefore Mathematicians use but one single proof in all their Propositions, after which other supernumerary ones would be but tedious; nevertheless, since all the several ways, by which we may look into the nature of our soul (the importantest subject we can busie our thoughts upon) cannot fail of being pleasing and delightful to us, we must not omit to reflect a little upon that great property of our soul, by which she is able to move and to work, without her self being moved or touched. Unto which adding, that all Life consisteth in motion, and that all motion of bodies cometh from some other thing without them; we may evidently conclude, that our soul, who can move without receiving her motion from a broad, hath in her self a spring of life; for the which she is not beholding (as Bodies are) to some extrinsecal cause of a nature like unto her; but only to him, who gave her to be what she is. But if she have such a spring of life within her, it were unreasonable to imagine, that she died upon the occasion of the death of another thing, that exerciseth no action of life, but as it is caused by another.

Neither may we neglect that ordinary consideration, which taketh notice, that our soul maketh use of Propositions of eternal truth, which we have above produced, among our proofs for her being of a spiritual nature; and shall now employ it for the proving her *immortal*: by considering, that the notion of *being*, which setteth these Propositions so, as they fear no mutation or shaking by time, is the very root of the soul, and that which giveth her her nature, and which sheweth it self in all her operations: so that, if from being, arriveth unto these Propositions to fear no time, the like must of necessity betide also the sub-

8.

The same is proved because she can move without being moved.

9.

The same is proved from her manner of operation which is grounded in *being*.

stance of the soul. And thus we see, that her nature is out of the reach of time: that she can comprehend time, and set it limits, and that she can think of things beyond it, and cast about for them. All which are clear testimonies, that she is free and secure from the all-devouring and destroying tyranny of that Saturnial Conqueror of the whole world of matter and of bodies, whose servant is death.

10.
Lastly it is proved from the science of Morality, the principles wherof would be destroyed if the soul were mortal.

After all these proofs drawn from the nature of the soul it self, every one of them of force to convince her immortality, I must crave leave to add one consideration more, though it seemeth to belong unto anothers harvest, namely to the science of Morals: and it is, that the position of mortality in the soul, taketh away all morality, and changeth men into beasts; by taking away the ground of all difference in those things, which are to govern our actions. For supposing that the soul dieth with the body; and seeing that man hath a comprehension or notion of time without end; it is evident, that the span of this life, must needs appear contemptible unto him that well considereth and weigheth it against the other infinite duration: and by consequence, all the goods, and evils which are parts of this life, must needs become as despicable and inconsiderable: so that better or worse in this life, hath not any appearance of difference between them; at the least, not enough to make him labour with pain to compass the one, and eschew the other, and for that end, to cross his present inclination in any thing, and engage himself in any the least difficult task: and so it would ensue, that if to an understanding man, some course or action were proposed unto him, as better than that he were going about, or for the instant had a minde unto, he would relish it, as a great Merchant, or a Banquier would do, who dealing for Millions, one should press him with earnestness, to make him change his resolved course, for the gain of a farthing more this way than the other; which being inconsiderable, he would not trouble his head with it, nor stop at what he was in hand with. In like manner, whosoever is perswaded that for an infinite of time he shall be *nothing*, and without sense of all things, he scorneth for this little twinkling of his life, to take any present pains to be in the next moment well, or to avoid being ill; since in this case, dying is a secure remedy to any present evil; and he is as ready to die now, as a hundred years hence; nor can he esteem

esteem the loss of a hundred years to be a matter of moment : and therefore he will, without any farther guidance or discourse betake himself to do whatsoever his present inclination beareth him to with most facility ; upon this resolution, that if any thing cross him, he will presently forgo his life, as a trifle not worth the keeping : and thus, neither virtue, nor honour, nor more pleasure than what at the present tickleth him, doth fall into his account: which is the overthrow of the whole body of *Morality*, that is of mans action and nature. But all they who look into sciences, do cross that for an erroneous and absurd Position, which taketh away the Principles of any Science : and consequently, the Position of the souls *Mortality*, is to be esteemed such. There remaineth yet one consideration more, and peradventure more important, than any we have yet mentioned, to convince the souls immortality : which is, that spiritual things are in a state of *being*. But we shall not be able to declare this until we have proceeded a little farther.

C H A P. X.

Declaring what the soul of a man, separated from his body, is : and of her knowledge and manner of working.

UNhappy man ! how long wilt thou be inquisitive and curious to thine own peril ? Hast thou not already payed too dear for thy knowing more than thy share ? Or hast thou not heard, that who will pry into Majesty, shall be oppressed by the glory of it ? Some are so curious (shall I say) or so ignorant, as to demand what a humane soul will be, after she is delivered from her body ; and unless they may see a picture of her, and have whereby to fancy her, they will not be perswaded, but that all are dreame, which our former discourses have concluded : as if he, who findeth himself dazeled with looking upon the Sun, had reason to complain of that glorious body, and not of his own weak eyes, that cannot entertain so resplendent a light.

Wherefore to frame some conceit of a separated soul, I will endeavour for their satisfaction to say somewhat of her future state. Let us then first consider what a thought is (I do not mean, that corporal spirit, which beareth at our common sense ; but that

1.
That the soul is one simple knowing act which is a pure substance and nothing but substance.

which is within, in the inward soul, whose nature we finde by discourse and effect; though we cannot see it in it self.) To this purpose we may observe, that if we are to discourse, or to do any thing, we are guided the right way in that subject we have in hand, by a multitude of particular thoughts; which are all of them terminated in that discourse or action: and consequently every act of our minde, is as it were an actual rule or direction, for some part of such discourse or action: so that we may conceive a compleat thought (compounded of many particular ones) to be a thing that ordereth one entire discourse or action of our life.

A thought being thus described, let us in the next place try, if we can make an apprehension, what a *Science* or an *Art* is: as, what the *Science* of *Astronomy* is; or what the art of playing on the *Organs* is, when the Astronomer thinketh not of the motions of the Heavens, nor the Organist of playing on his Instrument: which Science and Art do nevertheless even then reside in the Astronomer, and in the Organist: and we finde, that these are but the results of many former compleat thoughts; as being those very thoughts in remainder, whatsoever this may signifie.

Lastly, Let us conceive (if we can) a *power* or *capacity* to *being*: Unto which capacity, if any *being* be brought, that it is unseparably glewed and riveted unto it, by its very being a *being*: and if any two things be brought unto it by the vertue of one *being*, common to both those things, that both of them, by this one *being*, do become one betwixt themselves, and with this *capacity*; and that so there is no end or period of this addition of things, by the mediation of *being*; but that by links and rings, all the things that are in the world, may hang together betwixt themselves, and to this power; if all of them may be brought unto it by the Glew and vertue of *being*: in such sort as we have formerly declared, passeth in the Soul.

Now let us put this together, and make up such a thing, as groweth out of the capacity to *being* thus actuated, and cleaving to all things that any way have *being*: and we shall see, that it becometh a whole entire world, ordered and clinging together with a great strength and necessity, as can proceed from the nature of *being*, and of *contradiction*: and our reason will tell us, that

that such a thing, if it be active, can frame a world, such a one as we live in, and are a small parcell of, if it have matter to work upon; and can order whatsoever hath *being*, any way that it is capable of being ordered, to do by it, and to make of it, whatsoever can be done by, and made of such matter.

All these conceptions (especially by the assistance of the last) may serve a little to shadow out a perfect soul, which is, a *knowledge, an art, a rule, a direction of all things*: and all this by being all things in a degree and strain, proper and peculiar to it self: and an imperfect soul, is a participation of this Idea: that is, a knowledge, a rule, and a direction, for as much as it is, and as it attaineth unto. Now as in our thoughts it is the corporeal part onely which maketh a noise, and a shew outwardly, but the spiritual thought is no otherwise perceived than in its effect, in ordering the bodily acts; in like sort, we must not conceive this knowledge to be a *motion*; but meerly to be a *thing or being*, out of which the ordering and moving of other things doth flow, it self remaining fixed and immovable; and because all that is joyned unto it, is there riveted by *being, or identification*; and that when one thing is another, the other is again it; it is impossible that one should exceed the other, and be any thing that is not it: and therefore, in the soul there can be no parts, no accidents, no additions, no appendances, nothing that sticketh to it, and is not it: but whatsoever is in her, is *soul*, and the soul is all that which is within her; so that all that is of her, and all that belongeth unto her is nothing but one pure simple substance, peradventure Metaphysically, or formally divisible; (in such sort as we have explicated in the first Treatise of the divisibility between quantity and substance) but not quantitatively, as bodies are divisible. In fine, substance it is, and nothing but substance; all that is in it, being joyned and imp'd into it by the very nature of *being*, which maketh substance. This then, is the substantial conceit of a humane soul stripped of her body.

Now, to conceive what proprieties this substance is furnished with; let us reflect upon the notions we frame of things, when we consider them in common: as when we think of a man, of bread, of some particular virtue, of a vice, or of whatsoever else, and let us note, how in such, our discourse determineth no *place*, nor *time*; nay, if it should, it would mar the discourse; as Logicians shew, when

2.

That a separated soul is in no place, and yet is not absent from any place.

when they teach us, that scientificall syllogisms cannot be made without universal propositions: so that we see, unles these things be stripped from *Place* and *Time*, they are not according to our meaning: and yet nevertheless, we give them both the name and the nature of a *Thing*, or of a *substance*, or of a *living thing*, or of whatsoever else may by our manner of conceiving or endeavours, be freed from the subjection of *time* and *place*. Thus then we plainly see, that it is a very different thing, *to be*, and *to be in a place*: and therefore, out of a *Things being in no place*, it cannot be inferred, *That it is not*, or *that it is no substance*: nor contrariwise, out of *its being*, can it be inferred, *that it is in a place*: there is no man but of himself perceiveth the false consequence of this argument, a thing is, therefore it is hot, or it is cold: and the reason is, because hot and cold, are particular accidents of a body; and therefore a body can be without either of them. The like proportion is between *Being* in general, and *Being a Body*, or *Being in a Body*: for both these, are particular in respect of *Being*: but *to be in a place*, is nothing else, but *to be in a circumstant Body*: and so what is not in a *Body*, is not in a *Place*: therefore, as it were an absurd illation to say, *it is*, therefore it is in a *Body*; no less is it to say, *it is*, therefore it is *somewhere*; which is equivalent to, *in some Body*: and so a great Master (Peradventure one of the greatest, and judiciousst that ever have been) telleth us plainly, that of it self it is evident, to those who are truly learned, that *incorporeal substances are not in Place*: and *Aristotle* teacheth us, that *the Universe is not in Place*.

But now to make use of this discourse, we must intimate what it is we level at in it: we direct it to two ends; first, to lead on our thoughts, and to help our apprehension, in framing some conception of a spiritual substance, without residence in *Place*, and to prevent our fancies checking at such abstraction; since we see that we use it in our ordinary speech, when we think not on it, nor labour for it, in all universal and indefinite terms: next to trace out an eminent propriety of a separated soul: namely, that she is no where; and (yet upon the matter) that she is every where: that she is bound to no place, and yet remote from none: that she is able to work upon all, without shifting from one to another, or coming near any: and that she is free from all, without removing or parting from any one.

A second propriety, not much unlike the first, we shall discover in a separated soul, if we compare her with *time*. We have heretofore explicated, how *time* is the motion of the heavens; which giveth us our motion; which measureth all particular motions; and which comprehendeth all bodies, and maketh them await his leisure. From the large Empire of this proud Commander, a separated soul is free: For although she do consist with time, (that is to say, she is, whiles time is;) yet is she not in time; nor doth she in any of her actions, expect time; but she is able to frame time, to spin or weave it out of her self, and to master it.

3.

That a separated soul is not in time nor subject to it.

All which will appear manifestly, if we consider what it is to be in time. Aristotle sheweth us; that, to be comprehended under time, or to be in time, is, to be one of those moveables, whose being consisting in motion, taketh up but a part of time; and hath its terms, before, and behind, in time; and is measured by time; and must expect the flowing of Time, both for being, and for action. Now all this manifestly belongeth unto bodies, whose both action and being, is subject to a perpetual local motion and alteration: and consequently, a separated soul, who is totally a being, and hath her whole operation all together (as being nothing but her self when we speak of her perfective operation;) cannot be said to be in time, but is absolutely free from it; though time do glide by her, as it doth by other things: and so, all that she knoweth or can do, she doeth and knoweth at once, with one act of the understanding; or rather, *She is*, (indeed and really) *all that*: and therefore she doth not require time to manage, or order her thoughts, nor do they succeed one another, by such vicissitudes as men are forced to think of things by, because their fancies, and the images in it which beat upon the soul to make her think, whiles she is in the body, are corporal, and therefore do require time to move in, and to give way to one another: but she thinketh of all the things in the world, and of all that she can think of, together and at once; as hereafter we intend to shew.

4.

A third propriety we may conceive to be in a separated soul, by apprehending her to be an *Activity*; which that we may rightly understand, let us compare her in regard of working, with a body: reflecting then upon the nature of bodies, we shall find, that

That the soul is an active substance, and all in it is activity.

that not any of them will do the functions they are framed for, unless some other thing do stir them up, and cause them so to do. As for example; a knife, if it be thrust or pressed, will cut; otherwise, it will lie still and have no effect: and as it fareth with a knife, so it doth in the same manner with those bodies, which seem most to move themselves; as upon a little consideration, will appear plainly. A beast seemeth to move it self: but if we call to minde, what we have delivered upon this subject in the first Treatise, we shall finde, that whensoever he beginneth to move, he either perceiveth something by his sense, which causeth his motion, or else he remembreth something that is in his brain, which worketh the like effect. Now if sense presenteth him an object that causeth his motion, we see manifestly, that it is an external cause which maketh him move: but if memory do it, we shall finde that stirred by some other part; as by the stomack, or by the heart, which is empty, or heated, or hath received some other impression from another body, so that, sooner or later, we shall discover an outward mover. The like is in natural motions; as, in heavie things, their easie following (if they be sucked) another way than downwards, testifieth that their motion downwards hath an extrinsecal motor, as is before declared: and not onely in these, but throughout, in all other corporal things. So that in a word, all bodies are of this nature, that unless some other thing press them and alter them, when they are quiet, they remain so; and have no activity, otherwise than from an extrinsecal mover: but of the soul, we have declared the contrary; and that, by its nature, motion may proceed from it, without any mutation in it, or without its receiving any order, direction, or impulse, from an extrinsecal cause.

5. So that now summing up together all we have said upon this occasion, we finde a soul exempted from the body, to be, *An indivisible substance, exempted from place and time, yet present to both: an actual and present knowledge of all things that may be known: and a skill or rule, even by what it self is, to all things whatsoever.* This she is, if she be perfect: but if she be imperfect, then is she all this to the proportion of her growth, (if so I may say) and she is powerfull according to the measure of her knowledge, and of her will. So that in fine, a separated soul, is of a nature to have, and to know, and to govern all things.

I may

I may reasonably suspect, that my saying how imperfect souls are rules to the proportion of their growth, may have occasioned great reflection, and may have bred some trouble in the curious and heedful Reader. I confess: this expression was delivered by me, only to free my self for the present from the labour of shewing what knowledge every separated soul hath: but upon second thoughts, I finde that such standing over this difficult point will not serve my turn, nor save me the pains of untying this knot: for unlesse I explicate what I mean by that speech, I shall leave my Reader in great doubt and anxiety; which to free him from, I must wade a little farther in this question of the extent of a separated souls knowledge, into which, I have thus, upon the by, engaged my selfe: but let him first be advertised, that I do not here meddle, with what a separated soul may know by revelation, or by supernatural means: but that I do only track out her natural paths; and do guesse at what she is, or knoweth, by that light which her conversation in her body affordeth us.

Our entrance into this matter must be, to consider what mutation in respect of knowledge, a souls first change out of her body, waketh in her; for it is not unlikely, but that Nature may some way enlighten us so far, as to let us understand what must follow out of the negation of the bodies consortship, added unto what we know of her and other works in this world. This then first occurreth, that surely she cannot choose but still know in that state, all that she did know whilst she was in the body; since we are certain that the body hath no part in that which is true knowledge: as is above declared, when we shewed; first, that all true knowledge is respective; secondly, that the first impressions of the fanſie, do not reach to the interiour; souls and lastly, that she worketh by much more, then what hath any actual correspondence in the fanſie, and that all things are united to her by the force of *Being*: from which last, it followeth that all things she knoweth, are *her self*, and she is, *all that she knoweth*: wherefore, if she keepeth *her self* and her own *being*, she must needs keep the knowledge of all that she knew in this world.

6.

That a separated soul knoweth all that which she knew whilst she was in her body.

Next

7. Next, she must undoubtedly know then somewhat more, then That the least she knew in the body; for seeing that out of the things she already knoweth, others will follow by the meer ordering and connexion of them; and that the souls proper work, is to order which the soul acquireth in her body of things: we cannot doubt, but that, both the things she knoweth any one thing in this world, must of necessity be ordered in her to the best advantage; and likewise, that all that, will be known, which wanteth no other cause for the knowing of it, but the ordering of these things: For if the nature of a thing, were *Order*, who can doubt but what were put into that thing, were put into *Order*? Now, that the nature of the soul is such, we collect easily; for seeing that all order proceedeth from her, it must be acknowledged that *Order* is first in her: but what is in her, is her nature, her nature then is *Order*, and what is in her is ordered. In saying of which, I do not mean, that there is such an order between the notions of a separated soul, as is between material things, that are ordered by the soul whiles she is in the body; for seeing that the soul adæquate cause of such order; (that is to say a cause which can make any an such, and the whole kinde of it;) it followeth, that such order is not in her; for if it were she, would because of her self, or of her own parts. *Order* therefore, in her, must signifie a thing more eminent, than such inferiour order, in which resideth the power of making that inferiour *Order*: and this is nothing else, but the connexion of her notions by the necessity of *being*; which we have often explicated: And out for this eminent or superiour kinde of order, our conclusion followeth no lesse than if the inferiour order which we see in our fantasies, whiles our soul is in our body, did reside in our interiour soul; for, it is the necessity of identification, which doth the effect, and maketh the soul know; and the order of fantasms, is but a precedent condition in the bodily agents, that it may work upon the soul; and if more fantasms than one could be together, this order would not be necessary.

Out of this, a notable and a vast conclusion, manifestly followeth: to wit, that if a soul, can know any one thing more when she is out the body, then what she did know whiles she was in the body; without any manner of doubt, she knoweth all that can be

be drawn, and forced out of those knowledges, which she had in her body. How much this is, and how far it will reach, I am afraid to speak: only I entreat Mathematicians, and such as are acquainted with the manner how Sciences proceed; to consider how some of their definitions are made: to wit, by composing together sundry known terms, and giving a new name to the compound that resulteth out of them: wherefore clear it is, that out of fewer notions had at the first, the soul can make many more, and the more she hath, or maketh, the more she can multiply. Again, the maximies, which are necessary to be added unto the definitions for gaining of knowledge, we see are also compounded of ordinary and known terms; so that a seperated soul, can want neither the Definitions, nor the Maximies, out of which the books of Sciences are composed: and therefore, neither can the Sciences themselves be wanting unto her. Now if we consider, that in the same fashion as demonstrations are made, and knowledge is acquired in one Science, by the same means, there is a transcendence from Science to Science: and that there is a connexion among all the Sciences, which fall into the consideration of man, and indeed among all, at the least corporal things; (for of spiritual things, we cannot so assuredly affirm it; although their perfection may perswade us, that there is rather a greater connexion among them, than among corporal things) it will follow, that a soul which hath but any indifferent knowledge in this world, shall be replenished with all knowledge in the next.

But how much is this indifferent knowledge, that for this purpose is required in this world? Upon mature consideration of this point, it is true, I finde it absolutely necessary, that the soul must have here so much knowledge, as to be able to determine that some one thing, which hath connexion with all the rest, is in such a time: but then, why out of this very conception, she should not be able to climb up by degrees, to the knowledge of all other things whatsoever (since there is a connexion between that, and all the rest, and no untransfible gappe, or Chaos to sever them) I profess I do not see. Which if it be so, then the soul of an abortive in his mothers Womb, if he once arrive to have sense, and from it, to receive any impression in his soul, may for
ought

ought I know, or can suspect to the contrary, be endued in the next world with as much knowledge, as the soul of the greatest Clerk that ever lived: and if an abortive do not arrive so far, as to the knowledge of some one thing, I know no reason, why we should believe it arrived to the nature of man.

Whence it followeth, that this amplitude of knowledge, is common to all humane souls, (of what pitch soever they seem to be here) when they are separated from their bodies: as also, that if any error have crept into a mans judgement, during this life, whether it be of some universal conclusion, or of some particular thing, all such will be abolished then, by the truth appearing on the opposite side; thence two contradictory judgements, cannot possesse our soul together: as even in this world as well experience, as reason teacheth us.

8. But unawares I have engulphed my self into a sea of contradiction, from no mean adversaries: for *Alexander, Aphrodisens Pomponatius* and the learnedst of the Peripatetick School, will all of them rise up in main opposition against this doctrine of mine: shewing how in the body, all our souls knowledge is made, by the working of our fantasie; and that there is no part of our soul, without speculation of fantasms residing in our memory: therefore, seeing that when our body is gone, all those little bodies of fantasms are gone with it; what sign is there, that any operation can remain? And hence they infer, that seeing every substance hath its *Being* for its operations sake, and by consequence were vain and superfluous in the world, if it could not enjoy and exercise its operation; there is no necessity or end, why the soul of a man should survive his body: and consequently, there is no reason to imagine other, than that it perisheth when the man dieth. This is the substance of their Argument; which indeed is nothing else, but to guess without ground, or rather against all ground: but howsoever, this comfort I have, that I have to do with Peripatetikes; men that will hear and answer reason: and to such I addresse my speech.

To joyn issue then with them, and to encounter them with their own weapons, let us call to minde, what *Aristotle* holdeth light to be. He saith, *That it is a suddain and momentary emanation*

nation of what it is, following the precedent motion of some body, but without motion in it self. As for example: when the Sun commeth into our horison, (saith he) the illumination of the Horison, is an effect in an instant, following from the motion which the Sun had, since his setting in the other Hemisphere, untill he appear there againe: so that (according to him) the way of making this light, is the Sunnes local motion; but the effect or the *being enlightned*, is a thing of a very different nature, done without beginning, and continuing untill the Sunne depart againe from our Horison. And as he explicateth this action of illuminatton, in the same manner, doth he the actions of sense and of understanding. Upon all which I urge, that no Peripatetick will deny me, but that as in every particular sensation or thinking, there proceedeth a Corporall motion, out of which it ensueth, so this generall motion, which we call *the life of man*, precedeth that twinkle or moment, in which she becommeth an absolute spirit, or inhabitant of the next world. Wherefore it cannot bee said, that we introduce a doctrine alien from the Peripatetick way of Philosophising, if wee put a momentary effect or motion (according to their phrase of speaking) to follow out of the course of mans life; since they put diverse such effects, to follow out of particular parts of it.

Now, this momentary change, or what they please to call it, is that which maketh at one blow, all this knowledge we speak of: for, if we remember that knowledge is not a *doing* or a *motion*, but a *Being*; as is agreed between the Peripateticks and us; they cannot, for the continuing it, require instruments and motors: for they are necessary onely for change, not for *being*. Now, all this mighty change, which is made at the soules delivery, we conceive followeth precisely out of the change of her *Being*: for seeing it is supposed, that her *Being* was before in a body, but is now out of a body; it must of necessity follow, that all impediments, which grew out of her being in a body, must be taken away by her being freed from it. Among which impediments, one is, that time is then required betwixt her

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knowledge of one thing, and her knowledge of an other thing; and so her capacity, that of it self is infinite, becometh confined to that small multitude of objects, which the division and straightnesse of time giveth way unto. Now that, which length of time could in part work in the body, the same is entirely done in a moment, by the changing of her manner of *being*: for by taking away the bonds, by which she was enthralled in the body, and was kept in, to apprehend but according to the measure of the body, and was constrained to be, and to enjoy her self (as it were) but at the bodies permission; she is put in free possession of her self, and of all that is in her. And this is nothing else, but to have that large knowledge, we have spoken of, for her knowing all that, is no other thing but her being her self perfectly. Which will appear evident, if we consider that her nature is, *to be a Knower*, and that Knowledge is nothing else but a *Being of the object in the Knower*; for thence it followeth, that to know all things is nought else than to be all things: since then, we concluded by our former discourse, that all things were to be gathered out of any one; it is clear, that to be perfectly her self, and any one thing, is in truth to know all things.

And thus we see, that for the soules enjoyning all this knowledge when she is out of the body, she needeth no objects without her, no phantasmes, no instruments, no helps; but that all that is requisite, is contained absolutely in her being her self perfectly. And so we retort our Adversaries Objection on themselves; by representing to them, that since in their own doctrine, they require no body nor instruments for that precise action which they call understanding: it is without all ground, for them to require bodies and instruments in the next life, that the soul may there be that, which they acknowledge she is in her body without any such helps.

And as for that *Axiome* or experience, that the Soul doth not understand, unlesse she speculate phantasmes: as on the one side I yield to it, and confesse the experience, after the best and serioussest tryall I could make of it; so on the other side,

side, when I examine the matter to the bottom, I finde that it commeth not home to our adversaries intention. For as when we look upon a thing, we conceive we work upon that thing, whereas in truth we do but set our selves in such a position that the thing seen may work upon us: in like manner our looking upon the phantasmes in our brain; is not our souls action upon them, but it is our letting them beat at our common sense; that is, our letting them work upon our soul. The effect whereof is, that either our soul is bettered in her self, as when we study and contemplate: or else, that she bettereth something without us, as when by this thinking, we order any action.

But, if they will have this *Axiome* avail them, they should shew that the soul is not of her self a knowledge; which if they be able to do, even then when to our thinking, she seemeth not so much as to think, we will yield they have reason: but that will be impossible to them to do; for she is alwaies, of her self, a knowledge, though in the body she never expresseth so much, but when she is put to it. Or else they should shew, that this knowledge which the soul is of her self, will not by changing the manner of her *Existence*, become an actual knowledge, instead of the habitual knowledge which now appeareth in her.

But as these Aristotelians embrace and sticke to one *Axiome* of their Patron; so they forego and prevaricate against an other: for as it is *Aristotles* Doctrine, that a substance is for its operation, and were in vain and superfluous if it could not practise it; so likewise it is confessed doctrine, that *Matter* is for its *form*, and not the *form* for the *matter*. And yet these men pretend, that the soul serveth for nothing but the governing of the body: whereas contrariwise, both all *Aristotles* Doctrine, and common sense convinceth, that the body must be for the soul. Which if it be, nothing can be more consentaneous to Reason, than to conceive that the durance which the soul hath in the body, is assigned her, to work and mould in her the future state, which she is to have after this life: and that no more operations are to be expected from her

9.

The former
Peripatetikes
refuted out of
Aristotle.

after this life, but instead of them, a settled state of *Being*, seeing that, even in this life, according to *Aristotles* doctrine, the proper operations of the soul are but certain *Beings*: so that we may conclude, that if a soul were grown to the perfection, which her nature is capable of, she would be nothing else but a constant *Being*, never changing from the happiness of the best *Being*.

And although the texts of *Aristotle* which remain unto us, be uncertain (peradventure, not so much because they were originally such, in themselves, as through the mingling of some comments into the body of the text;) yet if we had his book which he wrote of the soul upon the death of his friend *Eudemus*, it is very likely we should there see his evident assertion of her *Immortality*; since it had been very impertinent to take occasion upon a friends death to write of the soul, if he intended to conclude, that of a dead man there were no soul.

10. Out of this discourse it appeareth, how those Actions which we exercise in this life, are to be understood, when we hear them attributed to the next: for to think that they are to be taken in their direct plaine meaning, and in that way, in which they are performed in this World, were a great simplicity, and were to imagine a likenesse between bodies and spirits; we must therefore elevate our mindes, when we would penetrate into the true meaning of such expressions, and consider how all the actions of our soule are eminently comprehended in the universality of knowledge, we have already explicated. And so, the Apprehensions, Judgements, Discourses, Reflections, Talkings together, and all other such actions of ours, when they are attributed to separated souls, are but inadæquate names and representations of their instantaneall sight of all things, for, in that, they cannot choose but see others mindes, which is that we call talking, and likewise their own, which we call reflection: the rest are plain parts, and are plainly contained in knowledge; discourse being but the falling into it; judgement the principles of it; and single apprehensions the components of judgements: then

The operations of a separated Soul compared to her operations in her body.

then for such actions as are the beginning of operation, there can be no doubt but that they are likewise to be found, and are resumed, in the same Universality; as, love of good, consultation, resolution, prudential election, and the first motion; for who knoweth all things, cannot choose but know what is good, and that good is to be prosecuted: and who seeth compleatly all the means of effecting and attaining to his intended good, hath already consulted and resolved of the best: and who understandeth perfectly the matter he is to work upon, hath already made his prudential election: so that there remaineth nothing more to be done, but to give the first impulse.

And thus you see, that this Universality of Knowledge in the soul, comprehendeth all, is all, performeth all; and no imaginable good or happiness, is out of her reach. A noble creature, and not to be cast away upon such trash as most men employ their thoughts in. Upon whom it is now time to reflect, and to consider, what effects the divers manners of living in this world, do work upon her in the next; if first we acquit our selves of a promise we made at the end of the last Chapter. For it being now amply declared, that the state of a Soul exempted from her body, is a state of pure *being*; it followeth manifestly, that there is neither action nor passion in that state: which being so, it is beyond all opposition that the soul cannot die: for it is evident, that all corruption must come from the action of another thing, upon that which is corrupted; and therefore that thing must be capable of *being* made better, and of being made worse. Now then, if a separated soul be in a final state, where she can neither be bettered, or worsened, (as she must be, if she be such a thing as we have declared) it followeth, that she cannot possibly lose the *Being* which she hath: and thence her passage out of the body, doth not change her nature, but onely her state; it is clear, that she is of the same nature even in the body: though in this her duration, she be subject to be forged (as it were) by the hammers of corporeal objects beating upon her; yet so, that of her self she still is what she is. And therefore as soon as she is out of the passible oore, in which she suffereth by reason of that oore, she presently becommeth impassible, as *being* purely of

her own nature, a fixed substance, that is, a pure *being*. Both which states of the soul, may in some sort be adumbrated by what we see passeth in the coppelling of a fixed metal; for as long as any led, or drosse, or allay remaineth with it, it continueth melted, flowing, and in motion under the muffle: but as soon as they are parted from it, and that it is become pure, without any mixture, and singly it self; it contracteth it self to a narrower room, and at that very instant, ceaseth from all motion, groweth hard, permanent, resistant unto all operations of fire, and suffereth no change or diminution in its substance by any outward violence we can use unto it.

CHAP. XI.

Shewing what effects, the divers manners of living in this world, do cause to a soul, after she is separated from her body.

I. **O**NE thing may peradventure seem of hard digestion in our past discourse; and it is, that out of the grounds we have laid, it seemeth to follow, that all souls will have an equality; since we have concluded, that the greatest shall see or know no more than the least: & indeed, there appeareth no cause why this great & noble creature, should be imprisoned in the obscure dungeon of noysome flesh; if in the first instant, in which it hath its first knowledge it hath then already gained all whatsoever it is capable of gaining in the whole progresse of a long life afterwards. Truly, the Platonick Philosophers (who are perswaded that a human soul doth not profit in this life, nor that she acquired any knowledge here; as being of her self compleatly perfect, and that all our discourses, are but her remembrings of what she had forgotten) will find themselves ill bested to render a Philosophical & sufficient cause of her being locked into a body: for to put forgetfulness in a pure spirit; so palpable an effect of corporeity, & so great a corruption, in respect of a creature whose nature is, to know of it self, is an unsufferable error. Besides, when they tell us, that she cannot be changed, because all change would prejudice the spiritual nature, which they attribute to her; but that well she may be warned and exalted by being in a body;

body; they meerly trifle: for either there is some true mutation made in her by that which they call a warning, or there is not; if there be not, how becommeth it a warning to her? Or what is it more to her than if a straw were wagged at the Antipodes? But if there be some mutation (be it never so little) made in her by a corporeal motion; what should hinder, why she may not by means of her body, attain unto science she never had; as well as by it receive any the least intrinsecall mutation whatsoever? For if once we admit any mutability in her from any corporeal motion, it is far more conformable unto reason to suppose it in regard of that which is her natural perfection, and of that, which by her operations we see she hath immediately after such corporeal motions, and whereof before them there appeared in her no marks at all; than to suppose it in regard of a dark intimation, of which we neither know it is, nor how it is performed. Surely, no Rational Philosopher seeing a thing, whose nature is to *know*, have a *being*, whereas formerly it existed not; and observing how that thing by little and little giveth signs of more and more knowledge, can doubt but that as she could be changed from not *being* to *being*; so, may she likewise be changed from lesse knowing, to more knowing.

This then being irrefragably settled, that in the body she doth encrease in knowledge: let us come to our difficulty, & examine what this encrease in the body availeth her; seeing that as soon as she parteth from it, she shall of her own nature enjoy, and be replenished with the knowledge of all things: why should she laboriously strive to anticipate the getting of a few drops which but encrease her thirst and anxiety; when having but a little patience, she shall at one full and everlasting draught drink up the whole sea of it? We know that the soul is a thing, made proportionably to the making of its body; seeing, it is the bodies compartner: and we have concluded, that whiles it is in the body, it acquireth perfection in that way, which the nature of it is capable of; that is, in knowledge: as the body acquireth perfection its way; which is, in strength and agility. Now then let us compare the proceedings of the one, with those of the other substance; and peradventure we may gain some light to discern what advantage it may prove unto a soul, to remain long

2.
That the knowleges which a soul getteth in this life will make her knowledge in the next life more perfect and firm.

in its body; if it make right use of its dwelling there; Let us consider the body of a man, well and exactly shaped in all his members; yet if he never use care, nor pains to exercise those well-framed limbs of his, he will want much of those corporeal perfections which others will have, who employ them sedulously. Though his legs, arms, and hands, be of an exact symmetry, yet he will not be able to run, to wrestle, or to throw a dart, with those who labour to perfect themselves in such exercises: though his fingers be never so neatly moulded or composed to all advantages of quick and smart motion; yet if he never learned and practised on the Lute, he will not be able with them to make any musick upon that instrument, even after he seeth plainly, and comprehendeth fully all that the cunningest Lutenist doth; neither will he be able to play, as he doth with his fingers, which of themselves are peradventure lesse apt for those voluble motions than his are. That which maketh a man dexterous in any of these Arts, or in any other operation, proper to any of the parts or limbs of his body, is the often repetitions of the same Acts; which do amend, and perfect those limbs in their motions, and which make them fit and ready for the actions they are designed unto.

In the same manner it fareth with the soule; whose essence is that which she knoweth: her severall knowledges may be compared, to arms, hands, fingers, legs, thighs, &c. in a body: and all her knowledges taken together, do compose (as I may say) and make her up, what she is. Now, those limbs of hers, though they be, when they are at the worst, entire, and well-shaped in bulk (to use the comparison of bodies) yet they are susceptible of farther perfection, as our corporeal limbs are, by often and orderly usage of them. When we iterate our acts of our understanding any object, the second act is of the same nature, as the first, the third as the second, and so of the rest: every one of which perfecteth the understanding of that thing, and of all that dependeth upon the knowledge of it, and maketh it become more vigorous and strong; even the often throwing of a boul at the same mark, begetteth still more and more strength and justness in the Arm that delivereth it: for, it cannot be denyed
but

but that the same cause which maketh any thing, must of necessity perfect and strengthen it, by repeating its force and strokes. We may then conclude that the knowledge of our soul, (which is indeed her self) will be in the next life more perfect and strong, or more slack and weak, according as in this life she hath often and vigorously, or faintly and seldom, busied her self about those things which beget such knowledge.

Now those things which men bestow their pains to know, we see are of two kinds: for some thirst after the knowledge of nature, and of the variety of things, which either their senses, or their discourse, tell them of: but others look no higher than to have an insight into humane action, or to gain skill in some Art, whereby they may acquire means to live. These latter curiosities, are but of particulars; that is, of some one, or few species, or kinds, whose common that comprehendeth them, falleth within the reach of every vulgar capacity; and consequently, the things which depend upon them, are low, mean, and contemptible: whereas the beauty, vastness, and excellency of the others, is so much beyond them, as they can be brought into no proportion to one another. Now then, if we consider, what advantage the one sort of these men, will in the next world have over the other, we shall finde, that they who spend their life here in the study and contemplation of the first noble objects, will, in the next, have their universal knowledge (that is their soul) strong and perfect: whiles the others, that played away their thoughts and time upon trifles, and seldom raised their mindes above the pitch of sense, will be faint through their former laziness, like bodies benumbed with the palsey, and sickly through their ill dyet, as when a well-shaped virgin, that having fed upon trash instead of nourishing meats, languisheth under a wearisome burthen of the green-sickness.

To make this point yet more clear, we may consider how the things which we gain knowledge of, do affect us under the title of good and convenient, in two several manners. The one is, when the appearance of good, in the abstracted nature of it, & after examination of all circumstances, carryeth our

3.

That the souls of men addicted to science whilst they lived here, are more perfect in the next world than the souls of unlearned men.

4.

That those souls which embrace virtue in this world will be most perfect in the next, and those which embrace vice most miserable.

our heart to the desire of the thing, that appeareth so unto us : the other is, when the semblance of good to our own particular persons without casting any further, or questioning whether any other regard may not make it prejudicial, doth cause in us a longing for the thing wherein such semblance shineth. Now for the most part the knowledges which spring out of the latter objects, are more cultivated by us, than those which arise out of the other ; partly by reason of their frequent occurring, either through necessity, or through judgement ; and partly, by the addition which passion giveth to the impressions they make upon us ? for passion multiplieth the thoughts of such things, more than of any others, if reason do not crosse and suppress her tumultuary motions, which in most men, she doth not. The souls then of such persons, as giving way to their passion, do in this life busie themselves about such things as appear good to their own persons, and cast no farther, must needs decede from their bodie, unequally builded, (if that expression may be permitted me ;) and will be like a lame unwieldy body, in which the principall limbs, are not able to govern and move the others ; because those principall ones are faint, through want of spirits and exercise ; and the others are overgrown with hydropical and nocive humours. The reason whereof is, that in such souls their judgements will be disproportioned to one another, one of them being unduely stronger than the other. What effect this worketh, in regard of knowledge, we have already declared, and no lesse will it have in respect of action : for suppose two judgements to be unequal, and such, as in the action one contradicteth the other, for example, let one of my judgements be, that it is good for me to eat because I am hungry ; and let the other be, that it is good for me to study, because I am shortly to give an account of my self ; if the one judgement be stronger than the other, as if that of eating be stronger than that of studying, it importeth not that there be more reason (all circumstances considered) for studying : because, reasons do move to action according to the measure in which the resolution that is taken upon them, is strong or weak ; and therefore, my action will follow the strongest

strongest judgement, and I shall leave my book to go to my dinner.

Now, to apply this to the state of a separated soul; we are to remember how the spirituall judgements, which she collected in the body, do remain in her after she is divested of it: and likewise, we are to consider, how all her proceeding in that state, is built, not upon passion, or any bodily causes or dispositions; but meerly upon the quality and force of those spiritual judgements: and then, it evidently followeth, that if there were any such action in the next life, the pure soul would apply it self thereunto, according to the proportion of her judgements, and as they are graduated and qualified. It is true, there is no such action remaining in the next life; yet neverthelesse there remaineth in the soul a disposition and a promptitude to such action; and if we will frame a right apprehension of a separated soul, we must conceit her to be of such a nature (for then all is nature with her, as hereafter we shall discourse,) as if she were a thing made for action in that proportion and efficacy, which the quartering of her by this variety of judgements doth afford; that is, that she is so much the more fit for one action than for another, (were she to proceed to action,) as the judgement of the goodnesse of one of these actions is stronger in her, than the judgement of the others goodnesse, which is in effect, by how much the one is more cultivated than the other. And out of this we may conclude, that what motions do follow in a man, out of discourse, the like will in a separated soul, follow out of her spiritual judgements. So that as he is joyed, if he do possess his desired good; and is discontented and displeased, if he misse of it, and seizeth greedily upon it when it is present to him, and then cleaveth fast unto it, and whiles he wanteth it, no other good affecteth him, but he is still longing after that Master-wish of his heart: the like in every regard, but much more vehemently, befalleth unto a separated soul. So that in fine she will be happy, or miserable, according as she hath built up herself, by her spiritual judgements and affections in this life. If knowledge and intellectual objects be the goods she thirsteth after, what can be happier than she, when she possesseth the fulness.

fulness of all that can be desired in that kinde? But if in this world a man setteth his heart constantly upon any transitory end; as upon wealth, corporeal delights, honor, power, and the like, (which are too short-breathed attendants to follow him so long a journey as into the next;) then, all the powers of his soul, even after she hath left her body, will be still longing after that dear Idol of her affections; and for the want of it, she will not value the great knowledge she shall then be imbued withall, nor care for any other good she possesseth; like a man who being surrounded with a full sea and swoln tide of all specious objects that may please and delight him, hath by unluckly chance suffered his violent affections, and his impotent desires to be intangled in some mean love, that either neglecteth him, or he is hindered from enjoying; and thereby, that little drop of gall, or rather that privation of a mean contentment (which truly in it self, is nothing) infecteth and poysoneth the whole draught of happiness, that but for this, would swell him up to the height of his wishes.

5.
The state of a
vicious soul in
the next life.

But no comparisons of sorrows, griefs, or anguishes in this life (where our earthly dwelling doth so clog, and allay, and dull the sense of our soul, which onely feeleth and reliseth either delight or wo) can arrive to shadow out the misery of a separated soul so affected; whose strains are so excessively vehement, and whose nature is a pure activity, and her self, all sense, all knowledge. It is true, I confesse, that in a man, such motions do in part proceed from passion: and therefore, I will allow, that so much of them, as have their origin meerly and onely from thence, shall die with the body, and shall not have made any impression in the separated soul: but besides the stream of passion we may in such motions observe also, the work of reason, for she, both approveth and employeth her powers, to compasse and gain what the other presenteth, and by legitimate discourse, draweth consequences out of that principle or judgement, which maketh the byas, it then leaneth unto: and these, are undeniable effects of a spiritual judgement settled in the soul. And therefore, as far as these motions proceed from spiritual judgments, so far, it is clear they must remain in the separated soul.

Peradventure

Peradventure, what I have said, may be lyable to a mistake; as though I conceived that these spirituall judgements are made in the soul according to right reason, and to legitimate discourse: whereas, I mean nothing lesse; but esteeming an overstrong judgement in the seperated soul, to be proportionable unto a passion in the body; I conceit, that as passion setteth reason on work to finde out means, whereby she may arrive unto her ends; so in like manner, may this judgement set reason on float, with those acts which follow consequently upon it (though inconsequent to the whole body of reason:) because the disorder there, is, in the excesse of this judgement over others, whose force (according to nature) ought to be greater than it. So that, if we would frame a conception of a disordered soul, when it is out of the body; we may imagine it correspondent to a body, whose one part were bigger than could stand in proportion with another, as, if the hand (to use the example we brought before) were greater than the arm could manage, or the foot were larger and heavier, than the leg and thigh could wield: unto which add, that every part were active and working of it self: so as, though it could not be governed, yet would it continually have its own operation, which would be contrary to the operation of the arme, or of the legge, and consequently, it would ever be tending to impossible operations: and by that means, both one member would alwaies disagree from the other, and neither of them attain any effect at all; not unlike to the fanfie of the Poets, who feigned a monster, which they termed *Scylla*, whose inferiour parts, were a company of dogs, ever snarling and quarrelling among themselves; and yet were unseverable from one another, as being compartes of the same substance.

But to declare this important doctrine more dogmatically; let us consider that of necessity a disordered soul hath these following judgements settled in her. Namely, that she is not well; that she cannot be well without her desired good; that it is impossible for her to compasse that good; and lastly, that this state she is in, is by all means possible to be avoyded; not by changing her judgement (for that is her self)

felt) but by procuring the satisfaction she desireth; and this with all the power, and total inclination of her activity and possibility. This then, being the temper of a disordered separated soul, it is easie to conceive, what a sad condition such an one remaineth then in; which is infinitely more, than any affliction that can happen to a man in this world: for since, even here, all our joyes and griefs, do proceed from our soul; we must needs allow, that when she shall be from the burthen of her body (which doth exceedingly impeach, and limit her operations, and activity) all her actions will be then far greater and more efficacious.

6. But because this point is of highest consequence, we may not slightly passe it over; but we will endeavour, if we can, to discover the wonderfull efficacy and force of a separated souls operations; that from thence we may the better collect, how great her happinesse or misery will be in the next life. Let us then consider, how an act or judgement of the soule, may be more forcible, either by it selfe, or by the multiplication of such helps, as do concur with it. To begin with considering the Act in it self, we know that the certaintest way to measure the strength of it, is to take a survey of the force which sheweth it self in its effect: for the being relatives to one another, each of them discovereth the others nature; Now, this we will do after our ordinary manner, by comparing the spirituall effects issuing from a judgement in the soul, to materiall effects proceeding from the operations and motions of bodies. In these we may observe three things, by which we may estimate their efficaciousnesse: some actions dure a longer time; others, take up a greater place, and others again, work the like effect in a greater place, and in a shorter time: which last sort, of all others, do proceed from the most powerfull, and most forcible agents. If then in these considerations we compare a separated soul to a body; what an infinity of strength and efficacy, will the meanest of those pure substances have, beyond the most powerfull and active body that can be imagined in Nature? For we have already shewed, how a separated soule comprehendeth at once, all place, and all times: so that, her activity requireth no application

The fundamental reason why as well happinesse as misery is so excessive in the next life.

cation to place or time; but, she is, of her self, mistress of both, comprehending all quantity whatsoever, in an indivisible apprehension; and ranking all the parts of motion, in their compleat order: and knowing at once, what is to happen in every one of them. On the other side; an incorporated soul, by reason of her being confined to the use of her senses, can look upon but one single definite place, or time, at once; and needeth a long chain of many discourses to comprehend all the circumstances of any one action: and yet after all, how short she is of comprehending all? So that comparing the one of these with the other, it is evident, that in respect of time and place; and in respect of any one singular action, the proportion of a separated soul, to one in the body, is as all time, or all place, in respect of any one piece, or least parcel of them; or as the entire absolute comprehender of all time and all place, is to the discoverer of a small measure of them. For whatsoever a soul willeth in that state, she willeth it for the whole extent of her duration; because she is then out of the state or capacity of changing: and wisheth for whatsoever she wisheth, as for her absolute good; and therefore employeth the whole force of her judgement, upon every particular wish. Likewise the eminency which a separated soul hath over place, is also then entirely employed upon every particular wish of hers; since in that state there is no variety of place left unto her, to wish for such good in one place, and to refuse it in another; as, whiles she is in the body hapneth to every thing she desireth. Wherefore, whatsoever she then wisheth for, she wisheth for it according to her comparison unto place: that is to say, that as such a soul hath a power to work at the same time in all place by the absolute comprehension, which she hath of place in abstract: so every wish of that soul if it were concerning a thing to be made in place, were able to make it in all places; through the excessive force and efficacy which she employeth upon every particular wish.

The third effect by which among bodies we gather the vigor and energy of the cause that produceth it, (to wit, the doing of the like action, in a lesser time and in a larger extent,) is but a combination of the two former: and therefore it requireth no further particular instance upon it, to shew, that likewise in this, the proportion of a separated to an incorporated

soul, must needs be the self same as in the others; seeing that a separated souls activity, is upon all place in an indivisible of time

Therefore to shut up this point; there remaineth onely for us to consider, what addition may be made unto the efficacy of a judgement, by the concurrence of other extrinsicall helps. We see that when an understanding man will settle any judgement, or conclusion in his mind, he weigheth thoroughly all that followeth out of such a judgement; and considereth likewise all the antecedents that lead him unto it: and if after due reflection, and examination, of whatsoever concerneth this conclusion which he is establishing in his minde, he findeth nothing to crosse it, but that every particular and circumstance goeth smoothly along with it, and strengtheneth it; he is then satisfied, and quiet in his thoughts, and yieldeth a full assent thereunto: which assent is the stronger, by how many the more concurrent testimonies he hath for it. And although he should have a perfect demonstration or sight of the thing in it self; yet every one of the other extrinsicall proofs, being as it were a new perswasion, hath in it a farther vigor to strengthen and content his minde in the forehad demonstration: for if every one of these be in it self sufficient to make the thing evident; it cannot happen that any one of them, should hinder the others: but contrariwise, every one of them must needs concur with all the rest, to the effectual quieting of his understanding, in its assent, to that judgement. Now then, according to this rate, let us calculate, (if we can) what concurrence of proofs and witnesses a separated soul will have to settle and strengthen her in every one of her judgements. We know, that all verities are chained, and connected one to another; and that there is no true conclusion so far remote from any other, but may by more, or lesse consequences and discourses, be deduced evidently out of it: it followeth then, that in the abstracted soul, where all such consequences are ready drawn, and seen in themselves without extension of time or employing of pains to collect them; every particular verity, beareth testimony to any other, so that every one of them is believed, and worketh in the sense and vertue of all. Out of which it is manifest, that every judgement in such a separated soul, hath an infinite strength and efficacy over any, made by an embodied one.

To

To sum all up in a few words : we finde three roots of infinity in every action of a separated soul, in respect of one in the body : first, the freedom of her essence or substance in it self : next, that quality of hers, by which she comprehendeth place and time ; that is, all permanent and successive quantity : and lastly, the concurrence of infinite knowledges to every action of hers. Having then this measure in our hands, let us apply it to a well-ordered, and to a disordered soul, passing out of this world: let us consider the one of them, ~~for~~ upon those goods, which she shall there have present, and shall fully enjoy : the other, languishing after, and pining away for those, which are impossible for her ever to obtain. What joy, what content, what exultation of minde, in any living man, can be conceived so great, as to be compared with the happiness of one of these souls? And what grief, what discontent, what misery can be like the others?

These are the different effects, which the divers manners of living in this world, do cause in souls after they are delivered from their bodies : out of which, and out of the discourse that hath discovered these effects unto us, we see a clear resolution of that so main and agitated question among the Philosophers, why a rational soul is imprisoned in a gross body of flesh and blood? In truth, the question is an illegitimate one ; as supposing a false ground : for the souls being in the body, is not an imprisonment of a thing that was existent, before the soul and body met together ; but her being there, is the natural course of beginning that, which can no other way come into the lists of nature : for should a soul, by the course of nature, obtain her first being without a body, either she would in the first instant of her being, be perfect in knowledge, or she would not: if she were, then should she be a perfect & compleat immaterial substance, not a soul ; whose nature is to be a companion to the body ; and to acquire her perfection by the mediation and service of corporeal senses : but if she were not perfect in science, but were onely a capacity thereunto, and like unto white paper, in which nothing were yet written ; then unless she were put into a body, she could never arrive to know any thing, because motion and alteration are effects peculiar to bodies : therefore, it must be agreed, that she is naturally designed to be in a body . but her being in a body, is her being one thing with the body, she is said to

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be

7.
The reason why mans soul requireth to be in a body, and to live for some space of time joyned with it.

be in : and so she is one part of a whole, which from its weaker part is determined to be a body.

Again, seeing that the matter of any thing, is to be prepared, before the end is prepared, for which that matter is to serve; according to that Axiome, *Quod est primum in intentione, est ultimum in executione* : we may not deny, but that the body is in being, some time before the soul ; or at the least, that it existeth as soon as she doth : and therefore, it appeareth wholly unreasonable, to say, that the soul was first made out of the body, and was afterwards thrust into it ; seeing that the body was prepared for the soul before, or at the least, as soon as she had any beginning : and so we may conclude, that of necessity the soul must be begun, layed, hatched, and perfected in the body.

And although it be true, that such souls as are separated from their bodies, in the first instant of their being there, are notwithstanding imbued with the knowledge of all things; yet is not their longer abode there in vain : not onely, because thereby the species is multiplied ; (for nature is not content with barely doing that, without addition of some good to the soul it self) but as for the wonderfull, and I may say infinite advantages that may thereby accrew to the soul, if she make right use of it : for, as any act of the abstracted soul is infinite, in comparison of the acts which men exercise in this life, (according to what we have already shewed) so by consequence, must any increase of it, be likewise infinite : and therefore we may conclude, that a long life well spent, is the greatest and most excellent gift, which nature can bestow upon a man.

8.
That the misery of the soul in the next world, proceedeth out of inequality, and not of falsity of her judgements.

The unwary Reader may perhaps have difficulty, at our often repeating of the infelicity of a miserable soul: since we say, that it proceedeth out of the judgements, she had formerly made in this life ; which without all doubt were false ones : and nevertheless, it is evident, that no false judgements, can remain in a soul, after she is separated from her body; as we have above determined. How then can a souls judgements, be the cause of her misery ? But the more heedfull Reader, will have noted, that the misery which we put in a soul, proceedeth out of the inequality, not out of the falsity of her judgements : for if a man be inclined to a lesser good, more than to a greater, he will in action betake himself to the lesser good,

good, and desert the greater, (wherein, neither judgement is false, nor either inclination is naught) meerly out of the improporcion of the two inclinations or judgments to their objects: for that a soul may be duly ordered, and in a state of being well, she must have a lesser inclination to a lesser good, and a greater inclination to a greater good: and in pure spirits, these inclinations are nothing else, but the strength of their judgments: which judgments in souls, whiles they are in their bodies, are made by the repetition of more acts from stronger causes, or in more favourable circumstances. And so it appeareth, how without any falsity in any judgement, a soul may become miserable, by her conversation in this world; where all her inclinations generally are good, unless the disproportion of them, do make them bad.

THE TWELFTH CHAPTER.

Of the perseverance of a soul, in the state she findeth her self in, at her first separation from her body.

THUS we have brought mans soul, out of the body she lived in here, and by which she conversed, and had commerce with the other parts of this world: and we have assigned her, her first array and stole, with which she may be seen in the next world: so that now there remaineth only for us to consider, what shall betide her afterwards; and whether any change may happen to her, and be made in her, after the first instant of her being a pure spirit, separated from all consortship with material substances. To determine this point the more clearly, let us call to mind, an axiom that Aristotle giveth us in his logick; which teacheth us, *That as it is true, if the effect be, there is a cause; so likewise it is most true, that if the cause be in act, or causing, the effect must also be.* Which Axiom may be understood two waies: the one, that if the cause hath its effect, then the effect also is: and this is no great mystery; or for it, are any thanks due to the teacher; it being but a repetition, and saying over again of the same thing. The other way is, that if the cause be perfect in the nature of being a cause, than the effect is: which is as much as to say, that if nothing be wanting to the cause, abstracting precisely from the effect; then neither is

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The explication, and proof of that maxim, that, if the cause be in act, the effect must also be.

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the effect wanting. And this is the meaning of *Aristotles* Axiom : of the truth and evidence whereof in this sense, if any man should make the least doubt, it were easie to evince it : as thus, if nothing be wanting but the effect, and yet the effect doth not immediately follow, it must needs be that it cannot follow at all; for if it can, and doth not, then something more must be done to make it follow : which is against the supposition, that nothing was wanting but the effect ; for that which it is to be done, was wanting. To say, it will follow without any change, is senseless : for if it follow without change, it followeth out of this, which is already put : but if it do follow out of this which is precisely put, then it followeth, against the supposition, which was, that it did not follow, although this were put.

2. This then being evident, let us apply it to our purpose ; and let us put three or more things, namely A.B.C. and D. whereof none can work otherwise, than in an instant or indivisibly : and I say, that whatsoever these four things are able to do, without respect to any other thing besides them, is compleatly done in the first instant of their being put : and if they remain for all eternity, without communication or respect to any other thing, there shall never be any innovation in any of them, or any farther working among them : but they will alwaies remain immutable, in the same state they were in, at the very first instant of their being put : for whatsoever A. can do, in the first instant, is in that first instant actually done ; because he worketh indivisibly : and what can be done precisely by A. and by his action joyned to B. doth precisely follow out of A. and his action, and out of B. and his action, if B. have any action independent of A. and because all these are in the same instant, whatsoever followeth precisely out of these, and out of any thing else that is in the same instant, and that worketh indivisibly as they do ; is necessarily done in that very instant ; but all the actions of C. and D. and of whatsoever by reflection from them may be done by A. and B. being all of them indivisible and following precisely out of some of the forenamed actions ; they do follow out of things being in this instant : and because they are indivisible, they may be in this instant : and therefore all is done in this instant. Now supposing all to be done that can be done by them in this instant ; & that nothing can follow from them, unless it follow precisely out of what is in this instant ; and that it is all indivisible :

it followeth clearly, that whatsoever (concerning them) is not in this instant, can never be.

These two conclusions being thus demonstrated; let us in the next place determine, how all actions of pure spirits, which have no respect to bodies, must of necessity be indivisible; that is, must include no continue succession: by which, I mean such a succession, as may be divided into parts without end: for if we look well into it, we shall finde, that a continue succession cannot be a thing, which hath in it self a *Being*: and the reason is, because the essence of such a succession, consisteth in having some of its parts already passed, and others of them yet to come: but on the other side, it is evident, that no such thing can be, whose essential ingredients are not it self: and therefore it followeth evidently, that such a thing as we call succession, can have no being in it self: seeing that one essential part of it, never is with the other: therefore, such a succession, must have its being in some permanent thing, which must be divisible; for that is essentially required in succession: but permanent divisibility is that, which we call bigness or quantity; from which pure spirits are free: and therefore, it is most evident, that all their actions in respect of themselves, are absolutely indivisible.

3.
All pure spirits do work instantaneously.

Now, to make use of this doctrine to our intent: we say, that since our soul, when it is separated from our body, is a pure spirit or understanding; and that all her actions are indivisible; and that all actions of other spirits upon her, must likewise be such; and by consequence, that there can be no continue succession of action among them: we must of necessity conclude, that according to the private nature of the soul, and according to the common notion of spiritual things; there can be no change made in her, after the first instant of her parting from her body: but what happiness or misery betideth her in that instant, continueth with her for all eternity. Yet it is not my minde to say, that by the course of the universal resolutions, from which she is not wholly exempt, and from supernatural administration of corporal things, there may not result some change in her. But the consideration of that matter, I remit to those treatises, unto which it belongeth; as not depending, nor ensuing from the particular nature of the soul: and therefore, not falling under our discussion in this place.

4.
That a soul separated from her body cannot suffer any change after the first instant of her separation.

This same Conclusion may be proved by another argument,
(H. h. h. 3.) besides

besides this which we have now used; and it is this. Whatsoever worketh purely by understanding and minde, cannot be changed in its operations, unless its understanding or minde, be altered: but this cannot happen, unless either it learn somewhat, it knew not before; or forgetting a foreknown truth, it begin afterwards to think a falsity. This second part, is impossible, as we have already shewed, when we proved that falshood could have no admittance into a separated soul: and the former is as impossible; it being likewise proved, that at her first instant of her separation, she knoweth all things: wherefore, we may hence confidently conclude, that no change of minde; (that is, no change at all) can happen to an abstracted soul.

5.
That temporal
sins are justly
punished with
eternal pains.

And thus, by discourse, we may arrive, to quit our selves easily of that famous objection, so much pestering Christian Religion; how God, can in justice impose eternal pains upon a soul, for one sin, acted in a short space of time. For we see, it followeth by the necessary course of nature, that if a man die in a disorderly affection to any thing, as to his chief good, he eternally remaineth by the necessity of his own nature, in the same affection: and there is no imparity, that to eternal sin, there should be imposed eternal punishment.

THE

THE CONCLUSION.

ANd now I hope, I may confidently say, I have been as good as my word : and I doubt not, but my Reader will finde it so, if he spend but half as much time in perusing these two Treatises, as the composing them hath cost me. They are too nice (and indeed, unreasonable) who expect to attain without pains, unto that, which hath cost others years of toil. Let us carefully pursue the hidden bounties he hath treasured up for us. Let them remember the words of holy *Job*, that *wisdom is not found in the hand of those, that live at their ease*. Let them cast their eyes on every side round about them, and then tell me, if they meet with any employment, that may be compared to the attaining unto these, and such like Principles ; whereby a man is enabled to govern himself understandingly and knowingly, towards the happiness, both of the next life and of this ; and to comprehend the wise mans theme ; *What is good for a man in the daies of his vanity, whiles he playeth the stranger under the sun*. Let us fear Gods judgments. Let us thank him for the knowledge he hath given us : and admire the excellency of Christian Religion ; which so plain'y teacheth us that, unto which it is so extreme hard to arrive by natural means. Let us bless him, that we are born unto it. And let us sing to him ; *That it is he, who preacheth his doctrine to Jacob, and giveth his laws to Israel. He hath not done the like to all nations ; nor hath he manifested his secret truths unto them*.

BUt before I cut off this thread, which hath cost me so much pains to spin out to this length ; I must crave my Readers leave, to make some use of it, for my own behoof. Hitherto my discourse hath been directed to him : now I shall intreat his patience, that I may reflect it in a word or two upon my self. And as I am sure I have profited my self not a little, by talking all this while to him, that obliging me to polish my conceptions with more care, and to range them into better order, than whiles they were but rude meditations within my own brest ; so I hope, that a little

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conversation with my self upon this important subject, (which is to be studied for use, and practice; not for speculative science) may prove advantageous unto him; if his warmed thoughts have turned his soul to such a key, as I am sure these considerations have wound up mine unto.

To thee then my soul, I now address my speech. For since by long debate, and toilsom rowing against the impetuous tides of ignorance, and false apprehensions, which overthrow thy banks, and hurry thee headlong down the stream, whiles thou art imprisoned in thy clayie mansion; we have with much ado arrived to aim at some little attome of thy vast greatness; and with the hard and tough blows of strict and wary reasoning, we have stricken out some few sparks of that glorious light, which environeth and swelleth thee, or rather, which is thee: it is high time, I should retire my self out of the turbulent and slippery field of eager strife and litigious disputation, to make my accounts with thee; where no outward noise may distract us, nor any way intermeddle between us, excepting onely that eternal verity, which by thee shineth upon my faint and gloomy eyes: and in which I see, whatsoever doth or can content thee in me. I have discovered, that thou (my soul) wilt survive me: and so survive me, as thou wilt also survive the mortality, and changes which belong to me; and which are but accidentary to thee, meerly because thou art in me. Then shall the vicissitude of time, and the inequality of dispositions in thee, be turned into the constancy of immortality; and into the evenness of one being, never to end, and never to receive a change, or succession to better or worse.

When my eye of contemplation hath been fixed upon this bright sun, as long as it is able to endure the radiant beams of it; whose redundant light veileth the looker on, with a dark mist: let me turn it for a little space, upon the streight passage, and narrow gullet, through which thou strivest (my soul) with faint and weary steps, during thy hazardous voyage upon the earth, to make thy self away: and let me examine, what comparison there is, between thy two conditions; the present one, wherein thou now findest thy self immersed in flesh and blood; and the future state that will betide thee, when thou shalt be melted out of this gross oar, and refined from this mean alloy. Let my terme of life, be of a thousand long years; longer than ever happened to our aged fore-fathers, who stored the earth with their numerous

progeny, by outliving, their skill to number the diffused multitudes that swarmed from their loyns : let me, during this long space, be sole Emperor and absolute Lord, of all the huge Glode of Land and water, encompassed with *Adams* off-spring : let all my subjects lie prostrate at my feet, with obedience and aw, distilling activest thoughts, in studying day and night to invent new pleasures and delight for me : let nature conspire with them, to give me a constant and vigorous health ; a perpetual spring of youth, that may to the full relish whatsoever good all they can fanſie: let graveſt Prelates, and greateſt Princes, ſerve inſtead of flatterers to lighten my joyes; and yet thoſe joyes, be raiſed above their power of flattery: let the wiſedom of this vaſt family (whoſe ſentiments, are maxims and oracles, to govern the worlds beliefs and actions) eſteem, reverence, and adorn me in the ſecretteſt, and the moſt recluſe withdrawings of their hearts : let all the wealth, which to this very day, hath ever been torn out of the bowels of the earth ; and all the treaſures, which the ſea hideth from the view of greedy men, ſwell round about me ; whiſt all the world beſides, lyeth gaping to receive the crumbs, that fall neglected by me, from my full loaden table : let my imagination be as vaſt, as the unfathomed Univerſity ; and let my felicity be as accompliſhed, as my imagination can reach unto; ſo that following in pleaſure, I be not able to thinke how to increaſe it, or what to wiſh for more, than that which I poſſeſſe and enjoy.

Thus when my thoughts are at a ſtand, and can raiſe my preſent happineſs no higher ; let me call to minde, how this long leaſe of pleaſant daies, will in time come to an end : this bottom of a thouſand joyful years, will at length be unwound, and nothing remain of it : and then (my ſoul) thy infinitely longer-lived Immortality will ſucceed ; thy never ending date will begin a new account, impoſſible to be ſummed up, and beyond all proportion infinitely exceeding the happineſs we have rudely aimed to expreſſe: ſo that no compariſon can be admitted between them. For, ſuppoſe firſt that ſuch it were, as the leaſt and ſhorteſt of thoſe manifold joyes, which ſwell it to that height we have fanſied, were equal to all the contentment thou ſhould'ſt enjoy in a whole million of years ; yet millions of years may be ſo often multiplied, as at length, the ſlender and limited contentments ſuppoſed in them, may equalle, & outgo the whole heap of overflowing bliſs,

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raised so high, in the large extent of these thousand happy years. Which when they are cast into a total sum; and that I compare it, with the unmeasurable eternity, which onely measureth thee; then I see, that all this huge product of Algebraical multiplication, appeareth as nothing, in respect of thy remaining, and reverending survivance; and is lesse, than the least point in regard of the immense Universe. But then, if it be true (as it is most true) that thy least spark and moment of real happiness, in that blessed eternity thou hopest for, is infinitely greater, and nobler, than the whole masse of fancied joyes, of my thousand years life here on earth; how infinitely will the value of thy duration, exceed all proportion, in regard of the felicity, I had imagined my self? And seeing there is no proportion between them, let me sadly reflect upon my own present condition: let me examine what it is, I so busily, and anxiously, employ my thoughts & precious time upon: let me consider my own courses, and whither they lead me: let me take a survey of the lives, and actions, of the greatest part of the world, which make so loud a noyse about my ears: and then may I justly sigh out from the bottom of my anguished heart; to what purpose have I hitherto lived? To what purpose are all these millions of toilsome antes, that live and labour about me? To what purpose were *Cesars* and *Alexanders*? To what purpose *Aristotles* and *Archimedes*? How miserably foolish are those conquering Tyrants, that divide the world with their lawless swords? What senseless idiots those acute Philosophers, who tear mens wits in pieces, by their different waies, and subtle Logick; striving to shew men beatitudes in this world, and seeking for that, which if they had found, were but a nothing of a nothing in respect of true beatitude? He onely is wise, who neglecting all that flesh and blood desireth, endeavoreth to purchase at any rate this felicity, which thy survivance promiseth: the least degree of which so far surmounteth all the heaps, which the Gyants of the earth are able to raise, by throwing hills upon hills, and striving in vain to scale and reach those eternities, which reside about the skys. Alas how fondly doth mankind suffer it self to be deluded? How true it is, that the only thing necessary, proveth the only that is neglected? Look up my soul, and fix thine eye upon that truth, which eternal light maketh so clear unto thee, shining upon thy face with so great evidence, as doth the noontide Sun, in its greatest brightness.

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And this it is, that every action of thine, be it never so slight, is mainly mischievous; or be it never so bedeck'd with those specious considerations, which the wise men of the world judge important, is foolish, absurd, and unworthy of a man; and unworthy of one that understandeth, and acknowledgeth thy dignity; if in it there be any speck; or if through it, there appear any spark of those mean and flat motives, which with a false bias, draw any way aside, from attaining that happiness, we expect in thee. That happiness, ought to be the end, and mark we level at: that, the rule and model of all our actions: that, the measure of every circumstance, of every atom, of whatsoever we bestow so precious a thing upon, as the employment of thee is.

But we must not so slightly passe over the intenseness and vehemence of that felicity which thou (my soul) shalt enjoy, when thou art severed from thy benumbing compartner. I see evidently, that thou dost not survive, a simple and dull essence; but art replenished with a vast and incomprehensible extent of riches & delight within thy self. I see that golden chain, which here by long discourses, filleth huge volums of Books, and diveth into the hidden natures of several bodies: in thee resumed into one circle or linke, which containeth in it self the large scope of whatsoever screwing discourse can reach unto. I see it comprehend, and master the whole world of bodies. I see every particular nature, as it were imbossed out to the life, in thy celestial garment. I see every solitary substance ranked in its due place and order, not crushed or thronged by the multitude of its fellows; but each of them in its full extent, in the full propriety of every part and effect of it; and distinguished into more divisions, than ever nature severed it into. In thee I see an infinite multitude enjoy place enough. I see, that neither height, nor profundity, nor longitude enough, nor latitude, are able to exempt themselves from diffused powers: they fadom all; they comprehend all; they master all; they enrich thee with the flock of all; and thou thy self art all, and somewhat more than all; and yet, now but one of all. I see, that every one of this all, in thee increaseth the strength, by which thou knowest any other of the same all: and all, encreaseth the knowledge of all, by a multiplication beyond the skill of Arithmetick; being (in its kinde) absolutely infinite; by having a nature, that is incapable of being either infinite or finite. I see again, that those things which have

not knowledge, are situated in the lowest, and meanest rank of creatures; and are in no wise comparable to those which know. I see, there is no pleasure at all, no happiness, no felicity, but by knowledge, and in knowledge. Experience teacheth me, how the purer, and nobler race of mankind, adoreth in their hearts, this idol of knowledge, and scorneth what ever else they seem to court, and to be fond of. And I see, that this excess of sea of knowledge which is in thee, groweth not by the succession of one thought after another; but it is like a full-swoln ocean, never ebbing on any coast, but equally pushing at all its bounds, and tumbling out its flowing waves on every side, and into every creek; so that every where it maketh high tide. Or like a pure Sun, which from all parts of it shooteth its radiant beams with a like extremity of violence. And I see likewise, that this admirable knowledge, is not begotten and conserved in thee, by the accidentary help of defective causes; but is rooted in thy self; is steeped in thy own essence, like an unextinguishable fource of a perpetually-streaming fire; or like the living head of an ever-running spring; beholding to none, out of thy self, saving onely to thy Almighty Creator; and begging of none; but being in thy self all that of which thou shouldest beg.

This then (my soul) being thy lot; and such a height of pleasure being reserved for thee; and such an extremity of felicity, within a short space attending thee; can any degenerate thought, ever gain strength enough, to shake the evidence which these considerations implant and rivet in thee? Can any dull oblivion deface this so lively and beautiful image? Or can any length of time, draw in thy memory a veil between it, and thy present attention? Can any perversity, so distort thy straight eyes, that thou shouldest not look alwaies fixed upon this mark; and level thy aim directly at this white? How is it possible, that thou canst brook to live, and not expire presently, thereby to ingulf thy self, and be thoroughly imbibed with such an overflowing blisse? Why dost thou not break the walls and the chains of thy flesh and blood, and leap into this glorious liberty? Here Stoicks, you are to use your swords. Upon these considerations, you may justify the letting out the blood, which by your discourses, you seem so prodigal of. To die upon these terms, is not to part with that, which you fondly call happy life; feeding your selves, and flattering your hearts

hearts with empty words : but rather it is, to plung your selves in to a felicity, you were never able to imagine, or to frame to your misguided thoughts any scantling of it.

But nature pulleth me by the ears, and warneth me from being so wrongful to her, as to conceive, that so wise a governess should to no advantage, condemn mankind so long a banishment, as the ordinary extent of his dull life, & wearisome pilgrimage here under the Sun reacheth unto. Can we imagine, she would allow him so much laisie time, to effeet nothing in ? or can we suspect that she intended him no farther advantage, than what an abortive child arriveth unto in his mothers wombe ? For whatsoever the nets and coils of discourse can circle in ; all that he, who but once knoweth that himself is, can attain unto as fully, as he that is enriched with the science of all things in the world. For the connexion of things, is so linked together, that proceeding from any one, you reach the knowledge of many ; and from many, you cannot fail of attaining of all : so that a separated soul, which doth but know her self, cannot chuse but know her body too ; and from her body, she cannot misse in proceeding from the causes of them both, as far as immediate causes do proceed from others over them : and as little can she be ignorant, of all the effects of those causes she reacheth unto. And thus, all that huge masse of knowledge, and happiness which we have considered in our last reflection, amounteth to no more, than the silliest soul buried in warm blood, can and will infallibly attain unto, when its time cometh. We may then assure our selves, that just nature hath provided and designed a greater measure of such felicity for longer livers : and so much greater, as may well be worth the pains and hazards of so miserable and tedious a passage, as here (my soul) thou strugglest through. For certainly, if the dull persecution, which by natures institution, hammoreth out a spiritual soul from grosse flesh and blood, can atcheive so wondrous an effect, by such blunt instruments, as are used in the contriving of a man : how can it be imagined, but that fifty or a hundred years beating upon far more subtile elements, refined in so long a time, as a child is becoming a man, and arriving to his perfect discourse, must necessarily forge out in such a soul, a strange and admirable excellency, about the unlicked form of an abortive embrion ? Surely, those innumerable strokes (every one of which maketh a strong impression in the soul,

upon whom they beat) cannot choose but work a mighty difference in the subj. & that receiveth them, changing it strangely from the condition it was in, before they begun to new mould it. What if I should say, the odds between two such souls, may peradventure be not unlike the difference between the wits and judgments of the subtlest Philosopher that ever was, and of the dullest child or idiot living? But this comparison falleth too short by far: even so much, that there is no resemblance: or proportion between the things compared: for as the excess of great numbers over one another, drowneth the excess of small ones, and maketh it not considerable, in respect of theirs, although they should be in the same proportion; so the advantages of a soul, forged to its highest perfection in a mans body, by its long abode there, and by its making right use of that precious time allowed it; must needs (in positive value, though not in Geometrical proportion) infinitely exceed, when it shall be delivered out of prison, the advantages, which the newly hatched soul of an abortive infant shall acquire, at the breaking of its chains. In this case, I believe no man would be of *Cæsars* minde; when he wished to be rather the first man in a contemptible poor Village, he passed through among the desert mountains, than the second man in *Rome*. Let us suppose, the wealth of the richest man in that barren habitation, to be one hundred Crowns; and that the next to him in substance, had but half so much as he: in like manner, in that opulent City, the head of the world, where millions were as familiar as pence in other places, let the excess of the richest mans wealth, be but (as in the former) double over his, that cometh next unto him; and there you shall find, that if the poorest of the two, be worth fifty millions, the other hath fifty millions more than he: whereas the formers petty treasure, exceedeth his neighbours but by fifty crowns. What proportion is there, in the common estimation of affairs, between that trivial summe, and fifty millions? Much less is there, between the excellency of a separated soul, first perfected in its body, and another that is set loose into compleat liberty, before its body arrived in a natural course, to be delivered into this world, and by its eye to enjoy the light of it. The change of every soul at its separation from the body, to a degree of perfection, above what is enjoyed in the body, is in a manner infinite: and by a like infinite proportion, every degree of perfection it had in the body, is also then multiplied:

ed: what a vast product then of infinity, must necessarily be raised, by this multiplying instant of the souls attaining liberty, in a well-moulded soul; infinitely beyond that perfection, which the soul of an infant dying before it be born, arriveth unto? And yet we have determined that to be in a manner infinite. Here our skill of Arithmetick and proportions faileth us. Here we find infinite excess, over what we also know to be infinite. How this can be, the feeble eyes of our limited understanding, are too dull to penetrate into: but that it is so, we are sure: the rigor of discourse convinceth and necessarily concludeth it. That assureth us, that since every impression upon the soul, while it is in its body, maketh a change in it; were there no others made, but merely the iterating of those acts which brought it from ignorance to knowledge; that soul, upon which a hundred of those acts had wrought, must have a hundred degrees of advantage over an other, upon which onely one had beaten; though by that one, it had acquired perfect knowledge of that thing: and then in the separation, these hundred degrees, being each of them infinitely multiplied, how infinitely must such a soul exceed in that particular, (though we know not how) the knowledge of the other soul; which though it be perfect in its kind, yet had but one act to forge it out? when we arrive to understand the difference of knowledge, between the superiour and inferiour ranks of intelligences; among whom, the lowest knoweth as much as the highest, and yet the knowledge of the highest, is infinitely more perfect and admirable, than the knowledge of his inferiours: then, and not before, we shall thoroughly comprehend this mystery. In the mean time, it is enough for us, that we are sure, that thus it fareth with souls: and that by how much the excellency and perfection of an all-knowing and all-comprehending soul, delivered out of the body of a wretched embrion, is above the vileness of that heavy lump of flesh, it lately quitted in his mothers womb; even by so much, and according to the same proportion, must the excellency of a compleat soul (compleated in its body) be in a pitch above the adorable majesty, wisdom, and augustness, of the greatest and most admired oracle in the world, living embodied in flesh and blood. Which as it is in a height, and eminency over such an excellent and admirable man, infinitely beyond the excess of such a man, over that silly lump of flesh, which composeth the most contemptible idiot or embryon; so likewise, is the excess

cells of it, over the soul of an abortive embryo, (though by the separation, grown never so knowing, and never so perfect) infinitely greater, than the dignity and wisdom of such a man, is above the feebleness and misery of a new animated child. Therefore have patience my soul: repine not at thy longer stay here in this veil of misery, where thou art banished from those unspeakable joys thou seest at hand before thee. Thou shalt have an overflowing reward for thy enduring and patienting in this thy darksome prison. Deprive not thy self through mischievous haste, of the great hopes and admirable felicity that attend thee, canst thou but with due temper stay for it. Be content to let thy stock lie out a while at interest; thy profits will come in vast proportions; and every year, every day, every hour, will pay thee interest upon interest: and the longer it runneth on, the more it multiplieth: and in the account thou shalt finde, if thou proceedest as thou shouldest, that one moment oftentimes bringeth in a greater increase unto thy stock of treasure, than the many years thou didst live and trade before: and the longer thou livest, the thicker will these moments arrive unto thee. In like manner as in Arithmetical numeration, every addition of the least figure, multiplieth the whole sum it findeth. Here thou wilt prove how true that rich man said, who of his gains pronounced, that he had gotten little with great labour, and great sums with little: so if thou bestowest well thy time, thy latter sums will bring thee in huge accounts of gain, upon small expence of pains or employments; whereas thy first beginnings are toilsome and full of pain, and bring in but slender profit.

By this time, my soul, I am sure thou art satisfied, that the excess of knowledge & of pleasure, which thou shalt enjoy, is vastly beyond any thou art capable of here. But how may we esteem the just proportion they have to one another? Or rather is not the pleasure of a separated soul, so infinitely beyond all that can be relished by one embodied here in clay, that there is no proportion between them? At the least, though we are not able to measure the one, let us do our best to aim and guesse at the improporcion between them; and rejoyce that we finde that it is beyond our reach to conceive or imagine any thing, nigh the truth and the huge excess of thy good (my soul) over the most I am capable of in this world. It is agreed, that the vehemence and intenseness of any pleasure, is proportionable to the activity, power, and energy of the subject, which

is affected with such pleasure; and to the gravitation, bent, and greatness, that such a subject hath to the object that delighteth it. Now to rove at the force and activity, wherewith a separated soul weigheth and striveth to joyn it self, to what its nature carrieth it unto; let us begin with considering the proportions of celerity and forcibleness, wherewith heavy bodies move downwards. I see a pound weight in one scale of the balance, weigheth up the other empty one with great celerity. But if into that you imagine a million of pounds to be put, you may well conceive, that this great excess, would carry up the single pound weight with so much violence and speed, as would hardly afford your eye liberty to observe the velocity of the motion. Let me multiply this million of pounds by the whole globe of the earth; by the vast extent of the great orb, made by the suns, or earths motion about the centre of the world; by the incomprehensibility of that immense store-house of matter and of bodies, which is designed in lump by the name of the Universe; of which we know no more, but that it is beyond all hope of being known, during this mortal life. Thus when I have heaped together a bulk of weight, equal to this unwieldy machine; let me multiply the strength of its velocity, and pressure over the least atome imaginable in nature, as far beyond the limits of gravity, as the ingenious skill, wherewith *Archimedes* numbred the least grains of sand that would fill the world, can carry it: and when I have thus wearied my self, and exhausted the power of *Arithmetick*, and of *Algebra*, I finde there is still a proportion between the atom and this unutterable weight: I see it is all quantitative; it is all finite; and all this excess vanisheth to nothing, and becometh invisible (like twinkling stars, at the rising of the much brighter sun) as soon as the lowest and the meanest substance shineth out of that orb, where they reside that scorn divisibility, and are out of the reach of quantity and matter. How vehement then must the activity and energy be, wherewith so puissant a substance shooeth it self to its desired object? and when it enjoyeth it, how violent must the extasie and transport be, wherewith it is delighted? How is it possible then for my narrow heart, to frame an apprehension of the infinite excess of thy pleasure (my soul) over all the pleasure this limited world can afford, which is all measured by such petty proportions? How should I stamp a figure of thy immense greatness, into my material imagination? Here I

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lose my power of speaking, because I have too much to speak of: I must become silent and dumb, because all the words and language I can use, express not the thousandth, nor the millionth part, of what I evidently see to be true. All I can say is, that whatsoever I think or imagine, it is not that: and that it is not like any of those things; unto some of which unless it be like, it is impossible for me to make any proportion or similitude unto it. What then shall I do, but lay my self down in mine own shadow, and there rejoyce that thou art a light so great, as I am not able to endure the dazling splendor of thy rayes; that thy pleasure is so excessive, as no part of it can enter into my circumscribed heart, without dilating it so wide, that it must break in sunder; and that thy happiness is so infinite, as the highest pitch I can hope for to glut my self withal, during this dark night of my tedious pilgrimage here on earth, is to see evidently, that it is impossible for me in this life, to frame any scantling of it; much less, to know how great it is? Shall I then once again presume to break out into impatience, at my delay of so great bliss, and cry out that I am content with the meanest share of this exuberant felicity? I care not for the exaggerations which a longer life may heap up unto it. I am sure here is sufficient to swell my heart beyond it self, to satisfy my thirsty soul, to dissolve and melt all my powers, and to transform me totally into a self-blessed creature. Away, away all tedious hopes, not onely of this life, but even of all increase in the next: I will leap boldly into that fountain of bliss, and cast my self headlong into that sea of felicity; where I can neither apprehend shallow waters, nor fear I shall be so little immersed and drowned, as to meet with any shelf or dry ground, to moderate and stint my happiness. A self-activity, and unbounded extent, and essence free from time and place, assure me sufficiently, that I need desire no more. Which way soever I look, I lose my sight, in seeing an infinity round about me: Length without points: Breadth without Lines: Depth without any surface. All content, all pleasure, all restless rest, all an unquietness and transport of delight, all an extasie of fruition.

Happy forgetfulness, how deeply am I obliged to thee, for making room for this soul-ravishing contemplation, by removing this whiles all other images of things far from me? I would to God thou mightest endure, whiles I endure; that so I might be drowned

drowned in this present thought, and never wake again, but into the enjoying, and accomplishment of my present enflamed desire. But alas, that may not be. The eternal light whom my soul and I have chosen for Arbitrator, to determine unto us what is most expedient for us, will not permit it. We must return; and that into fears and miseries: For as a good life breedeth encrease of happiness, so doth an evil one, heap up Iliads of woe. First (my soul) before I venture, we should be certain, that thy parting from this life, wasts thee over to assured happiness: For thou well knowest, that there are noxious actions, which deprave and infect the soul, whiles it is forging and moulding here its body, and tempering for its future being: and if thou shouldest fall hence in such a perverse disposition, unhappiness should betide thee instead of thy presumed bliss. I see some men so ravenous after those pleasures, which cannot be enjoyed out of the body, that if those impotent desires accompany their souls into eternity, I cannot doubt of their enduring an eternity of misery: I cannot doubt of their being tormented with such a dire extremity of unsatisfiable desire, and violent grief, as were able to tear all this world into pieces, were it converted into one heart; and to rive in sunder, any thing less than the necessity of contradiction. How high the bliss of a well-governed soul is above all power of quantity, so extreme must the ravenous inclemency, & vulture-like cruelty, be of such an uncompassable desire gnawing eternally upon the soul; for the same reason holdeth in both: and which way soever the gravitation and desires of a separated soul do carry it, it is hurried on with a like impetuosity and unlimited activity. Let me then cast an heedfull and wary eye, upon the actions of the generality of mankind, from whence I may guess at the weal or woe, of their future state: and if I find that the greatest number weigheth down in the scale of misery, have I not reason to fear lest my lot should prove among theirs? For the greatest part sweepeth along with it every particular, that hath not some particular reason to exempt it from the general law. Instead then of a few that wisely settle their hearts on legitimate desires, what multitudes of wretched men do I see? some hungry after flesh and blood; others gaping after the empty winds of honour & vanity; others breathing nothing but ambitious thoughts; others grasping all, and groveling upon heaps of melted earth? So that they put me all in a horror, and make me fear, lest very few they
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be, that are exempted from the dreadfull fate of this incomprehensible misery, to which I see, and grieve to see, the whole face of mankind desperately turned. May it not then be my sad chance, to be one of their unhappy number? Be content then, fond man, to live. Live yet, till thou hast first secured the passage which thou art but once to venture on. Be sure before thou throwest thy self into it, to put thy soul into the scales: balance all thy thoughts; examine all thy inclinations; put thy self to the test, try what dross, what pure gold is in thy self: and what thou findest wanting, be sure to supply, before nature calleth thee to thy dreadfull account. It is soon done, if thou beest what thy nature dictateth thee to be. Follow but evident reason and knowledge, and thy wants are supplied, thy accounts are made up. The same ever-shining truth, which maketh thee see that two and two are four, will shew thee without any contradiction, how all these base allurements are vain & idle; and that there is no comparison between the highest of them, and the meanest of what thou mayest hope for, hast thou but strength to settle thy heart by the steerage of this most evident science; in this very moment, thou mayest be secure. But the hazard is great, in missing to examine thy self truly and thoroughly. And if thou miscarry there, thou art lost for ever. Apply therefore all thy care, all thy industry to that. Let that be thy continual study, and thy perpetual entertainment. Think nothing else worth the knowing, nothing else worth the doing, but screwing up thy soul unto this height, but directing it by this level, by this rule. Then fear not, nor admit the least doubt of thy being happy, when thy time shall come; and that time shall have no more power over thee. In the mean season, spare no pains, forbear no diligence, employ all exactness, burn in summer, freeze in winter, watch by night, and labour by day, joyn moneths to moneths, entail years upon years. Think nothing sufficient to prevent so maine a hazard; and deeme nothing long or tedious in this life, to purchase so happy an eternity. The first discoverers of the Indies, cast themselves among swarms of man-eaters; they fought and struggled with unknown waies: so horrid ones, that oftentimes they perswade themselves they climbed up mountains of waters, and straight again were precipitated headlong down between the cloven sea, upon the foaming sand, from whence they could not hope for a resource: hunger was their food; snakes and
serpents.

serpents were their dainties; sword and fire were their daily exercise: and all this, only to be masters of a little gold, which after a short possession was to quit them for ever. Our searchers after the Northern passage, have cut their way through mountains of yce, more affrightful and horrible, than the *Symplegades*. They have imprisoned themselves in half year nights; they have chained themselves in perpetual stone-cleaving colds: some have bin found closely imbracing one another, to conserve as long as they were able, a little fewel in their freezing hearts, at length petrified by the hardness of the unmercifulness of that unmerciful winter: others have been made the prey of unhumane men, more savage than the wildest beasts: others have been never found nor heard of, so that surely they have proved the food of ugly monsters of that vast ycy sea: and these have been able and understanding men. What motives, what hopes had these daring men? what gains could they promise themselves, to countervail their desperate attempts? They aimed not so much as at the purchase of any treasure for themselves, but meerly to second the desires of those that set them on work; or to fill the mouths of others, from whence some few crumbs might fall to them. What is required at thy hands (my soul) like this? And yet the hazard thou art to avoid, and the wealth thou art to attain unto, incomparably over-setteth all that they could hope for. Live then and be glad of long and numerous years; that like ripe fruit, thou mayest drop securely into that passage, which duly entered into, shall deliver thee into an eternity of blis, and of unperishable happinese.

And yet (my soul) be thou not too sore agast, with the apprehension of the dreadfull hazard thou art in. Let not a tormenting fear of the dangers, that surrounded thee, make thy whole life here bitter and uncomfortable to thee. Let the serious and due consideration of them, arm thee with caution and wisdom, to prevent miscarriage by them. But to look upon them with horror and affrightedness, would freeze thy spirits, and benum thy actions, and peradventure engulf thee through pusillanimity in as great mischiefs, as thou seekest to avoid. Tis true, the harm which would acruë from misgoverning thy passage out of this life, is unspeakable, is unimaginable. But why shouldest thou take so deep thoughts of the hazard thou runnest therein, as though the difficulty of avoiding it were so extreme, as might amount to an impossibility.

I allow, the thoughts that arm thee with wise caution to secure thy self, cannot be too deep nor too serious; but when thou hast providently stored thy self with such, call thy spirits manfully about thee: and to encourage thee to fight confidently, or rather to secure thee of victory, so thou wilt not forsake thy self, turn thine eyes round about thee, and consider how wise nature, that hath prescribed an end and period unto all her plants, hath furnished them all with due and orderly means to attain therunto: and though particulars sometimes miscarry in their journey (since contingency is entailed to all created things) yet in the generality, and for the most part, they all arrive unto the scope she leveleth them at. Why then should we imagine, that so judicious and far-looking an Architect, whom we see so accurate in his meaner works, should have framed this masterpiece of the world, to perish by the way, and never to attain unto that great end, for which he made it; even after he is prepared and armed with all advantagious circumstances agreeable to his nature? That artificer, we know, deserveth the stile of silly, who frameth such tools, as fail in their performance, when they are applied to the action for which they were intended. We see all sorts of trees for the most part bear their fruit in due season; which is the end they are assigned unto, and the last and highest emolument they are made to afford us. Few beasts we see there are, but contribute to our service what we look for at their hands. The swine affordeth good flesh, the sheep good wooll, the cow good milk, the sable warm and soft fur, the ox bendeth his sturdy neck to the yoke, the spiritfull horse dutifully beareth the souldier, and the sinewy mule and stronger camel convey weighty merchandise. Why then shall even the better sort of mankind, the chief, the top, the head, of all the works of nature, be apprehended to miscarry from his end in so vast a proportion, as that it should be deemed in a manner impossible, even for those few (for so they are in respect of the other numerous multitude of the worse sort) to attain unto that felicity which is natural unto them? Thou (my soul) art the form, and that supreme part of me, which giveth being both to me, and to my body: who then can doubt, but that all the rest of me, is framed fitting and serviceable for thee? For what reason were there, that thou shouldest be implanted in a soyl, which cannot bear thy fruit? The form of a hog, I see, is engrafted in a body fit and appropriated for a swines operations:

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the form of a horse, of a lion, of a wolf, all of them have their organs proportioned to the mastering piece within them, their soul. And is it credible, that onely man, should have his inferiour parts raised so highly in rebellion against his soul, the greatest Mistress (beyond proportion) among all forms, as that it shall be impossible for her to suppress their mutinies, though she guide her self never so exactly by the prescripts of that rule, which is born with her? Can it be suspected, that his form, which is infinitely mounted above the power of matter, should through the very necessity and principles of its own nature, be more liable to contingency, than those that are engulfed and drowned in it? since we know, that contingency, defectibility, and change, are the lame children of gross and mishapen matter.

Alas it is too true, that nature is in us unhappily wrested from her original & due course. We find by sad experience, that although her depravation be not so total, as to bind entirely the eye of Reason she seeth by, yet it is so great, as to carry vehemently our affections quite cross to what she proposeth us as best. Howsoever, let the incentives of flesh and blood be never so violent, to tumble humane nature down the hill; yet if a contrary force, more efficacious than they with all their turbulent and misty streams, do impel it another way, it must needs obey that stronger power. Let us then examine whose motives, the souls, or the senses, in their own nature, work most efficaciously in man. We are sure, that what pleasure he receiveth, he receiveth by means of his soul; even all corporeal pleasure: for, be the working object never so agreeable and pleasing unto him, he reapeth thence small delight, if in the mean time, his souls attention be carried another way from it. Certainly then, those things must affect the soul most powerfully, which are connatural unto her, and which she seizeth upon and reliseth immediately; rather than those impure ones, which come sophisticated to her, through the muddy channels of the senses. And accordingly, all experience teacheth us, that her pleasures, when they are fully savoured, are much stronger than the pleasures of our senses. Observe but the different comportments of an ambitious, and of a sensual man, and you wil evidently perceive far stronger motions, and more vehement strains in the former, who hath his desires bent to the satisfaction of his mind, than in the other, who aimeth but at the pleasures of his body. Let us
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look upon the common face of mankind; and we shall see the most illustrious and noble part, taken with learning, with power, with honor; and the other part, which maketh sense their idol, moveth in a lower and baser orb under the others; and is in a servile degree to them. Since then humane nature is of it self more inclined to the contentments of the active minde, than of the dul sense; who can doubt but that the way of those pure contentments, must be far sweeter than the gross and troubled streams of sensual pleasures? which if it be, certainly man in his own nature, is more apt to follow that: and when he chanceth to wander out of that smooth and easie road, his steps are painfull and wearisom ones: and if he do not presently perceive them such, it is, because it fa- reth with him, as with those that walk in their sleep, and stray into rough and stony passages, or among thistles and briers; whiles peradventure some illuding dream bewitcheth their fancies, and perswadeth them they are in some pleasant garden; till waking, (if at least they wake before they fall into a deadly precipice) they finde their feet all gored, and their bodies all scratched and torn. If any sensual man should doubt of this great truth, and find it hard to perswade himself, that intellectual pleasures (which to his depraved taste, seem cold and flat ones) should be more active and intense, than those seculent ones, which so violently transport him; let him but exercise himself a while in those entertainments which delight the mind, taking leave during that space, of those unruly ones, which agitate the body; and continue doing thus, till by long practice, he hath made them easie, and habitated himself unto them: and I will engage my word, that he will finde this change so advantagious to him, even in contentment and delight, that he will not easily be brought back to his former course of life. Experience sheweth us, that whatsoever is long customary to us, turneth into our nature; so much, that even diseases and poysons by diuturn use, do mould and temper to themselves those bodies, which are habituated to them; in such sort, that those pests of nature must be kept on foot, and fed upon for our substance. How much more then must the most connatural exercise of natural pleasure, turn so substantially in our being, that after some good practice in it, we shall not be able, without great strugling and reluctance, to live without it.

The violence of fruition in those foal puddles of flesh and blood,
presently

presently glutted with satiety, and is attended with annoy and with dislike: & the often using and repeating it, weareth away that edge of pleasure, which onely maketh it sweet and valuable, even to them that set their hearts upon it; and nothing heighteneth it, but an irritation by a convenient hunger and abstinence. Contrariwise, in the soul, the great and more violent the pleasure is, the more intense and vehement the fruition is; and the oftner it is repeated, so much the greater appetite and desire we have to return unto the same; and nothing provoketh us more, than the entire and absolute fruition of it. If a suddain change from one extreame of flesh and blood, to the other opposite pole of spiritual delights and entertainments, seem harsh to him, whose thoughts by long assuefaction are glewed to corporal objects; let him begin with gently bridling in his inferiour motions under a fair rule of government: If he cannot presently suppress and totally mortifie their clamorous desires, let him at the least moderate and steer them according to the bent of reason. If we will but follow this course which nature teacheth us, to heighten even our sensual delights and pleasures, by reasonable moderation of them to their own advantage; we shall finde her so kinde a mother to us, that of her self she will at length quell and disincumber us of all our enemies. If we but temperately attend her work, she will quietly waite us over to our desired end, to our beloved happiness. In a few years, by boiling away our unruly heat, she will abate, and in the end quite wear away the sense of those transporting pleasures we used to take so much delight in the fruition of. With in a while, rheumes will so clog our tongue and palates, that we shall but flatly relish the most poyant meats. Our dulled ears will no longer devour with delight, the ravishing sound of sweet harmonies. Our dim eyes will carry to our heavy fanisie but confused news of any beautiful and pleasing objects. Our stopped nostrils will afford no passage for spiritusful perfumes, to warm and recreate our moist and drowsie brain. In a word, nature will ere long warn us to take a long farewell of all those contentments and delights, which require a strong, vigorous, and athletick habit of body to enjoy. She will shew us, by setting our graves before our eyes, how vain this glittering fanisie of honor is: how unprofitable the staffe of power to underprop our falling being; how more burthensome than helpful are those massie heaps of gold and sil-

ver, which when we have, the greatest use we make of them, is but to look upon them, and court them with our dazeled eyes; whiles they encompasse us with armies of traytors and of hungry wolves, to tear them from us, and us in pieces for their sake. Thus will nature of her self in a short time, dull those weapons that offend us, and destroy the enemies of those verities that shine upon us. Courage then, my soul, and neither fear to live, nor yet desire to die. If thou continuest in thy body, it is easie for thee, and sweet and contentfome to heap up treasures for eternity. And if thou partest from it, thy hopes are great and fair, that the journey thou art going, is to a world of unknown felicity. Take heart then, and march on then with a secure diligence, and expect the hand of bounteous nature, to dispose of thee, according as she hath wisely and benignly provided for thee. And fear not, but that if thou hast kept a reasonable amity with her, she will passe thee to where thou shalt never more be in danger of jarring with her; nor of feeling within thy self the unkind blows of contrary powers fighting in thee, whiles thou bledest with the wounds that each side giveth; nor of changing thy once-gained happiness into a contrary condition, according to the vicissitudes of all human affairs: But shalt *For ever*, be swelled to the utmost extent of thy infinite nature, with this torrent, with this abyss of joy, pleasure, and delight.

But here (my soul) well mayest thou stand amazed at this great word *For ever*. What will this be, when fleeting time shall be converted into permanent eternity? sharpen thy sight to look into this vast profundity. Suppose that half an hour, were resumed into one instant or indivisible of time: what a strange kinde of durance would that be? I see that half an hour, is divisible without end, into halfe, and halfe of halfe, and quarters of quarters; and after myriads of divisions, no parcel is so little, but that it hath an infinite superproportion to an indivisible instant. What a prodigious thing then must it be, to have an instant equalise half an hour? were it but some ordinary notion or quiddity, as of magnitude, of place, of activity, or the like, in which this excellency of an indivisibles equalising a large extent, were considered; my fantasie would offer to wrestle with it; and peradventure, by strong abstraction; & by deep retirement into the closet of judgment, I might hazard to frame some likeness of it. But that wherein this multiplication

is, is the noblest, the highest, and the root of all other notions, it is *Being* and *Existence* it self. I my self, whiles I am, have my existence determined but to one poor instant of time; and beyond that, I am assured of nothing. My slender thred of *Being* may break, I still finde that it may break asunder, as neer to that instant, as I can suppose any thing to be neer unto it: and when I shall have supposed, *Here* it may break neerer and neerer; and that I can never arrive to settle the neereſt point where it may snap in two. But when time shall be no more, or at the least, shall in respect of me, be turned into Eternity; then this frail Existence of mine, will be stretched out beyond the extent of all-conquering time. What strange thing then, is this admirable multiplication of existence? or how may I be able to comprehend it? Existence is that which comprehendeth all things: and if God be not comprehended in it, thereby it is, that he is incomprehensible of us: and he is not comprehended in it, because himself is it. He is Existence; and by being so, he comprehendeth, not comprehendeth it. From hence then I may gather the excellency and vast empire of existence, in its own nature: and so conclude how admirable a change and betterment that must be, which encreaseth, and multiplieth so infinitely the existence I now enjoy; for be it never so specious; be it never so glorious; be it what it is, existence, the top, the flower, the perfection of all created things; still there is a flaw, there is a defect, a shortness, a limitation in it: for now, my soul, thou art but a part of me; and dost exist in such a manner by succession, that the security and possession of it, is of less than of any thing whatsoever in the world; for it is of nothing more, than of an indivisible; which being such, in truth is nothing. But when the walls shall be broken down, that here confine thee to such a nothing of existence, (which yet is infinitely more noble, than all other degrees of notions) then thou shalt sum up time in formal *being*, and not be limited, as now thou art, to this so divided a succession. Thou shalt be an hour without divisibility: and if an hour, a year: if so, an age: and if an age, then for ever, for all Eternity.

But whither art thou flown, my soul? to what a dazeling height art thou mounted? Thou art now soared to such a lessening pitch, as my faint eyes are no longer able to follow thy touring flight: my head groweth giddy, with gazing up; whiles thou lookest down, to see time run an infinite distance beneath thee;

(LII 2)

wasting

wasting the existence of all corporal things from nothing to nothing, in a perpetual stream: and thou secure, and out of the reach of its venomous and all-destroying truth. Let me call to mind, all the violent pleasures of my heady youth: let me sum up their extent according to those deceitful measures I then rated happiness by: let me in my fancy chew over again the excessive good I then fondly imagined in them: and to all this, let me add as much more joy and felicity, as in my weak thought, I am able to fathom or but aim at: and then let me say (and with rigorous truth I shall say it) all this excess of bliss, will be resumed, will be enjoyed to the full, in one indivisible moment: let me think with my self, if then, when pleasure was the idol I sacrificed all my thoughts unto, I might in one quarter of an hour have enjoyed a pleasure, or at the least, have hoped for one, that should have equalled at once all those, that in my life I ever tasted: what would not I have been content to give in purchase of that single quarter of an hour? and instead of this pleasant dream, I now see that one real moment, will truly and solidly give to thee and me, the quintessence, the elixir of content and happiness; not drawn out of such 40 years, as I have struggled through the world in various fortunes; but out of ages and ages of pleasure, greater far than can be conceived by a heart of flesh; and multiplied beyond the Arithmetick of intelligences. And this happy moment, shall not be of their suddain fleeting and expiring nature, that are assigned to time; but shall endure beyond the extent of that time, which surpasseth all multiplication. I see plainly that I must multiply eternity, by eternity, to frame a scantling of that bliss, which a well-passed life in this world, shall bring me to in the next. And yet it will be as far short, and as much beneath the self-blessedness of him that giveth one this, as nothing is short of all that is. For my bliss shall have a beginning; and though it never shall have end, yet that belongeth not to it for its own sake, but proceedeth meerly from the bounteous hand of the nothing annihilating self essence: from whom there is no more fear of the failing of his liberal superfluence of *Being* upon me, than there is of his own deficiency from being self *Being*. But how can these things stand together? That indivisibly I shall possess a tenure beyond all possible time? and nevertheless *possibly*, notwithstanding my possession, I may be bereft of what I enjoy? who can read this riddle? who can dive into.

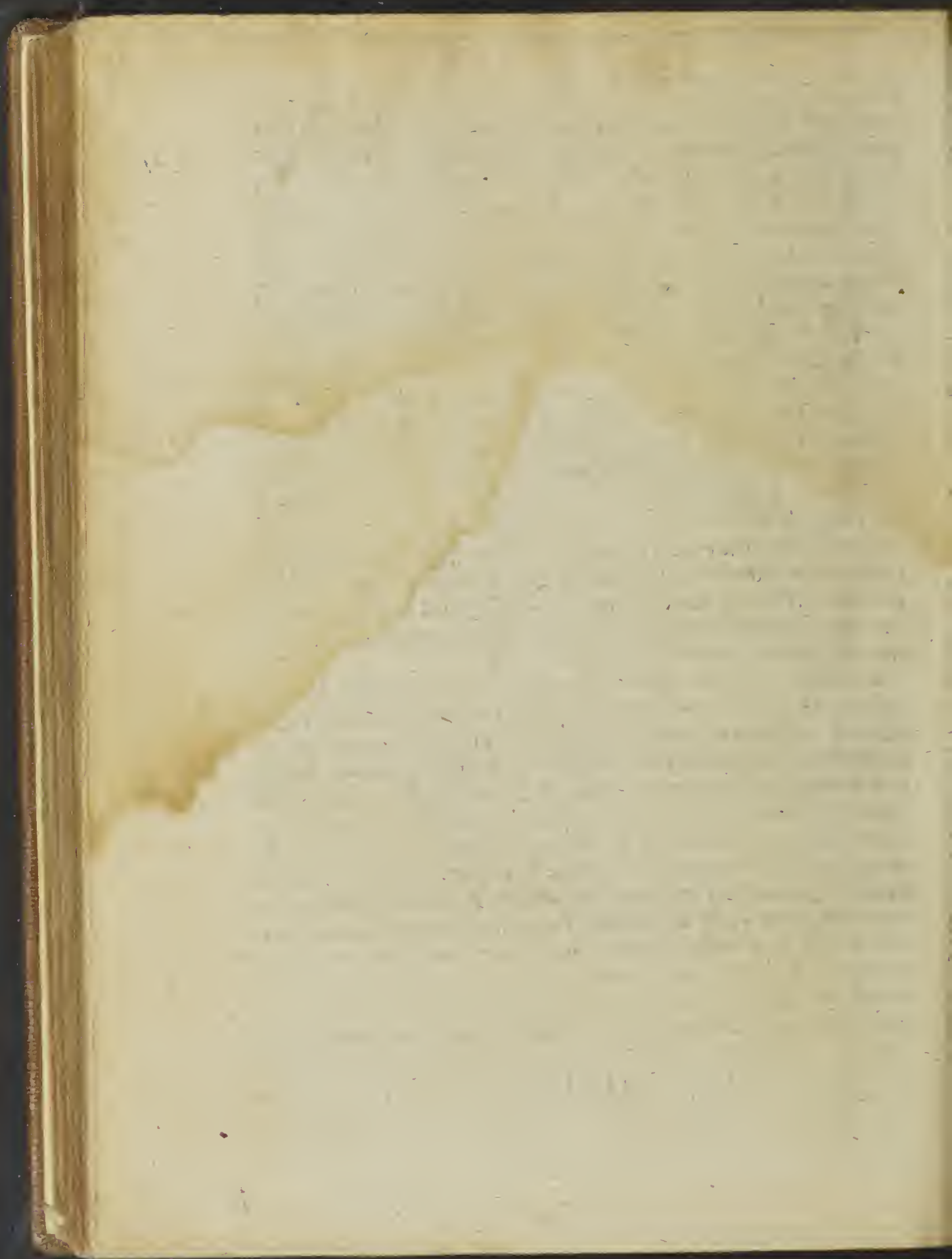
into this abyſs? who can ſhoot light into this infinite pit of darkneſs? It is the abundance and exceſs of light that here ſtriketh us blinde. Who can ſtrengthen our eyes to endure eagle-wiſe this glorious and reſplendent Sun? Nothing ſure in this world; unleſs it be ſilence and ſolitude. To theſe therefore let us conſecrate the reverend contemplation of this awfull myſtery; which is but profaned, if it be expoſed to vulgar eyes: and to ſuch night-owles and battes as we are, whiles the troubled fanſies of recking ſenſe and worldly occupations do overcloud my ary thoughts.

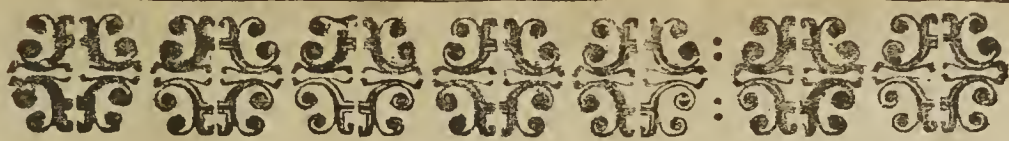
Now then if nature by ſhort and thick ſteps at the beginning, and by larger paces in the progreſs, hath delivered us over into a night of pure light, where we can ſee nothing, becauſe every thing is too viſible; ſo that we are ſain to veil our eyes, and are conſtrained to retire our ſelves to meditate and arm them, before we expoſe them to ſo ſtrong and glorious beams: how ſhould we dare to look upon theſe admirable heights (infinitely ſurpaſſing all theſe) with which the overconquering grace hath crowned and ſwelled up the extent of nature? What ſight is ſharp enough to penetrate into the myſterious eſſence, ſprouting into different perſons? Who can look upon the ſelf-multiplied unity, upon the incomprehenſible circuminceſſion, upon thoſe wondrous proceſſions, and idioms reſerved for Angels eyes?

Of theſe, (my ſoul) whoſe ſhootings reach infinitely higher beyond all that we have ſaid, than what we have ſaid is beyond the dull and muddy motions of this life; thou art not capable now of receiving any inſtructions: let firſt the myſtagogical illuminations of the great Areopagite; and the Aſceticke diſcipline of the Anachoretical inhabitants of the wilderneſs, purifie the eye, before thou attempteſt to ſpeak, or to aim at the diſcovery of theſe abyſſing depths. By them thou muſt be firſt irrigated with the ſweet ſhowers of mornings and evenings, with the gentle dews and manna-drops, which fall abundantly from thoſe bounteous favours that reſide in a higher ſphear than nature, and that pour out unknown and unconceivable bleſſings upon prepared hearts: which fructifie into that true bleſs, in compariſon whereof, all that we have hitherto declared, is but ſhadow, vanity, and nothing.

FINIS.

P R R





PRIVILEGE DU ROY.



OVYS PAR LA GRACE DE DIEU
ROY DE FRANCE ET DE NAVARRE,
A nos amez & feaux les gens tenans nos Cours de
Parlemens, Baillifs, Seneschaux, Prevosts, leurs
Lieutenans, & tous autres nos Justiciers & Officiers
qn'il appartiendra, Salut, *Le Sieur Kenelme Digby*
Chevalier Anglois, nous a fait remonstrer qu'il a composé un Liure
en langue Angloise, contenant deux Traitez, l'un de la nature du
corps, & l'autre de la nature des ames, avec une recherche de l'im-
mortalité de celles qui sont raisonnables. Lequel il desireroit mettre
en lumiere & faire imprimer, s'il avoit nos lettres à ce nécessaires:
lesquel les nous faisant supplier luy vouloir octroyer. A ces causes
luy avons permis & accordé, permettons & accordons par ces pre-
sentes faire imprimer & debiter ledit Liure pendant sixans. Du-
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d'amende, confiscation des exemplaires qui s'en trouveront, & de
tous despens dommages & interests envers luy. Si vous mandons
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celle de nullité desdites presentes. Car tel est nostre plaisir nonob-
stant oppositions ou appellations quelconques, clameur de Haro,
chartre Normande & lettres à ce contraires. Donné à Fontaine-
bleau le vingt-sixiesme jour de Septembre, l'an de grace mil six cens
quarantequatre, & de nostre Regne le deuxiesme.

Par le Roy en son Conseil.

GVITONNEAU.

Handwritten text at the top of the page, possibly a title or header, which is mostly illegible due to fading.

Second line of handwritten text, appearing to be a date or a specific reference.

Main body of handwritten text, consisting of several paragraphs. The text is significantly faded and obscured by a large, irregular water stain on the left side of the page.

Bottom section of handwritten text, which appears to be a concluding paragraph or a signature block.

